(MABI 2002)

Part 5: Potential Effects of the Alternatives

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Part 5: Potential Effects of the Alternatives

This chapter examines the potential effects on Park resources of the four alternatives described in Section 3.2. The National Environmental Policy Act (NEPA) requires all federal agencies to analyze the potential environmental impacts of proposed federal actions, and to identify any adverse environmental effects that cannot be avoided should the proposed action be implemented. This analysis provides the basis for comparing the alternatives.

First, a brief description of methods and definitions used in the analysis is provided in Section 5.1. In Section 5.2, the effects of the alternatives on Park resources are summarized in a table. These effects then are described in greater detail in Sections 5.3 through 5.8. In both the table and the subsequent narrative description, effects on the key integrated landscape features identified in Section 2.2 are addressed first. Then the effects on other Park attributes are analyzed, including cultural resources, natural resources, sustainable management practices, education and interpretation, and visitor use and community connections.

Section 5.9 addresses other topics that were not analyzed in detail because they either do not exist at the Park or they would not be affected by any of the four alternatives. Potential cumulative effects on Park resources from the alternatives and other unrelated actions are described in Section 5.10, and the topic of potential impairment of those resources under any of the alternatives is addressed in Section 5.11. Part 5 concludes with the identification of the environmentally preferred and NPS-preferred alternatives in Sections 5.12 and 5.13.

In addition to the analysis for NEPA, Section 106 of the National Historic Preservation Act (NHPA) also requires analysis of effects on cultural resources. This is provided in Section 5.3, which will be reviewed with the Vermont State Historic Preservation Office through the development of a programmatic agreement.

From top: Logging with horses (J. Roberts 2004); forest dynamic monitoring plot (MABI 2001); field work during Trails Workshop (Chuck Wise 2004); crop tree workshop (MABI 1999).

5.1 Methods and Definitions

In accordance with the National Environmental Policy Act and NPS policies, the potential effects of the four alternatives on relevant aspects of the human environment were analyzed. Altogether, potential effects were considered for twenty-seven specific topics related to the resources and management of the Mount Tom Forest. These topics were identified as priorities for analysis by the planning team during the scoping phase and the refinement of the management alternatives. An additional six topics were considered but ultimately dismissed from detailed analysis (see Section 5.9). The impact analysis and conclusions were based on Park-specific resource inventories and studies; review of other relevant literature; information provided by professionals from other National Park Service offices and other agencies and organizations; and the planning team's interdisciplinary knowledge and experience.

For the purpose of the analysis, the following five definitions were used:

Intensity:

- Negligible: Impact to the resource is barely perceptible or not measurable, and confined to a small area.
- Minor: Impact to the resource or discipline is perceptible or measurable, but it is localized.
- Moderate: Impact is clearly detectable and could have appreciable effect on the resource or discipline.
- Major: Impact would have a substantial, highly noticeable influence on the resource or discipline.

Impact Type:

- Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.

Duration of Effect:

- Short-term: Impacts that would be less than five years in duration.
- Mid-term: Impacts that would last approximately fifteen to twenty years.
- Long-term: Impacts that would be more than twentyyears in duration.

Cumulative effects:

The collective impacts to a particular resource from the combination of the incremental impact of a particular action and the impacts from other past, present, and reasonably foreseeable future actions.

Impairment:

An impact so severe that, in the professional judgment of a responsible NPS manager, it would harm the integrity of park resources or values and violate the 1916 NPS Organic Act.[1]

5.2 Summary of Potential Effects of the Alternatives

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A **Continue current management**	*Alternative B* **Adopt a "replacement-in-kind" approach to historic preservation**	*Alternative C* **Continue the tradition of applying the best current thinking and practice in forest management**	*Alternative D (NPS-preferred)* **Recognize and work with ecological change in preserving the historic character of the forest**
Integrated Features				
Landscape Patchwork: Cover Types	Over the long term Alternative A would maintain the general configuration of forest, agricultural fields, and open water.	Same as Alternative A, but some short-term changes in the patchwork character when areas are cleared to reestablish plantations.	Same as Alternative A, but a small portion of the Maple Lot would be reforested to expand the forested buffer along the Pogue Stream.	Same as Alternative C.
Landscape Patchwork: Forest Stand Types	Over the long term, the diversity of stand types would decrease as plantations and early-successional forest stands transition to native forest dominated by later-successional, native hardwood and mixed forest stands.	Over the long term, the most exact representation of the existing cover types would be retained.	Same as Alternative A, but the change would occur more quickly because of active forest management.	Same as Alternative C, with some aspects of Alternative B because some plantations or portions of plantations would be maintained as long as possible, encouraged to regenerate with conifer species, or replanted.
Forest Architecture: Stand Age, Structure, and Diversity	Over the long term, both plantations and hardwood and mixed forest stands would develop an uneven-aged character and greater diversity.	Over the long term, the most exact representation of the existing forest stand structure and diversity would be maintained.	Same as Alternative A, but the change would occur more quickly because of active forest management.	Same as Alternative C, with some aspects of Alternative B because some plantations or portions of plantations would be maintained as even-aged, single-species, and in other areas even-aged conifer regeneration would be encouraged.
Forest Architecture: Downed Coarse Woody Debris and Snags	In the long term, Alternative A would generate the greatest amount of deadwood throughout the Park.	Current levels and distribution of dead wood throughout the Park would be maintained. Therefore, this alternative would provide the least increase in CWD or snags over the long term.	Over the long term, amounts of CWD and snags would be less than in Alternative A. However, in the short and mid-term, Alternative C would create the greatest amount of deadwood because harvesting would generate more CWD that would be left to decay.	Over the long term, amounts of CWD and snags would be similar to Alternative C. However, CWD along some segments of the carriage roads would be removed, and a higher number of snags would be retained in forest stands.
Legacy Trees	Over the long term, Alternative A would create the greatest abundance and distribution of legacy trees with old-growth characteristics. However, legacy trees associated with the designed characteristics of the Forest would be lost.	The overall diversity, abundance, and relative distribution of the legacy trees of both cultural and ecological value would be comparable to what currently exists.	Alternative C would have the fewest legacy trees because active forest management would encourage the removal of most mature, well-formed trees.	Over the long term, Alternative D would create the greatest diversity and abundance of legacy trees of both cultural and ecological value.

TABLE 5
SUMMARY OF THE POTENTIAL EFFECTS OF THE ALTERNATIVES

	Alternative A **Continue current management**	*Alternative B* **Adopt a "replacement-in-kind" approach to historic preservation**	*Alternative C* **Continue the tradition of applying the best current thinking and practice in forest management**	*Alternative D (NPS-preferred)* **Recognize and work with ecological change in preserving the historic character of the forest**
Cultural Resources				
Cultural Landscapes	Alternative A would have a major adverse effect on cultural landscape resources and a Section 106 determination of adverse effect.	Alternative B would have moderate beneficial effects on cultural landscape resources and a Section 106 determination of no adverse effect.	Alternative C would have a moderate adverse effect on cultural landscape resources and a Section 106 determination of adverse effect.	Alternative D would have a minor beneficial effect on cultural landscape resources and a Section 106 determination of no adverse effect.
Archeological Resources	None of the alternatives would negatively affect archeological resources.			
Ethnographic Resources	None of the alternatives would negatively affect ethnographical resources.			
Natural Resources				
Soils	Alternative A would have negligible effects on soil resources.	Alternative B would have the potential to cause moderate adverse effects on soil resources in the long term. Mitigation measures may need to be extensive and might not be successful.	Alternative C would have the potential for causing minor adverse effects. These impacts could be easily mitigated if the best management practices outlined in Appendix C are implemented.	Same as Alternative C
Water Resources and Wetlands	Alternative A would have negligible effects on water and wetland resources.	Alternative B would have the potential to cause moderate, adverse effects on water and wetland resources in the long term. Mitigation measures may need to be extensive and might not be successful.	Alternative C would have the potential to cause minor adverse effects. These impacts could be easily mitigated if the best management practices outlined in Appendix C are implemented.	Same as Alternative C.
Wildlife: Species of Concern	None of the alternatives would negatively affect wildlife species of concern.			
Wildlife: Reptiles and Amphibians	Alternative A would provide moderate beneficial impacts to reptile and amphibian habitat and populations in the long term.	Alternative B is unlikely to have any noticeable impact on reptile and amphibian habitats or populations over the long term.	Same as Alternative A, although some potential minor impacts from soil compaction.	Alternative D would provide beneficial impacts to reptile and amphibian populations, but to a lesser extent than Alternatives A and C.
Wildlife: Birds	Alternative A would provide moderate beneficial impacts to the greatest number of bird species in the long term.	Alternative B is unlikely to have any noticeable impact on bird populations over the long term.	Alternative C would provide moderate beneficial impacts to bird species that require cavities for nesting, forest interior, and edge habitats. Alternative C would also provide some early-successional habitat that is absent from the other alternatives.	Same as Alternative C, except Alternative D would not create any additional early-successional habitat.
Wildlife: Mammals	Alternative A would provide moderate beneficial impacts to mammal populations over the long term.	Alternative B is unlikely to have any noticeable impact on mammal populations over the long term.	Same as Alternative A, but Alternative C would begin to provide these beneficial impacts in the short and mid-term.	Same as Alternative C, but to a lesser extent because some plantation areas would be retained.

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A **Continue current management**	*Alternative B* **Adopt a "replacement-in-kind" approach to historic preservation**	*Alternative C* **Continue the tradition of applying the best current thinking and practice in forest management**	*Alternative D (NPS-preferred)* **Recognize and work with ecological change in preserving the historic character of the forest**
Wildlife: Fish	None of the alternatives would negatively impact fish populations at the Park.			
Vegetation: Natural Communities	Alternative A would have the greatest beneficial impacts on the development of natural communities to their full potential.	Alternative B would not provide any noticeable beneficial impacts to natural community development.	Similar to Alternative A, but to a lesser extent because some natural communities may not develop to their full potential.	Same as Alternative C, but to a lesser extent because some plantation areas would be retained.
Vegetation: Native Plant Species of Special Concern	Alternative A would have moderate beneficial impacts on habitat associated with native plant species of special concern over the long term.	Alternative B would be unlikely to have any noticeable impact on native plant species of concern over the long term.	Alternative C would have minor beneficial impacts on habitat associated with native plant species of special concern over the long term.	Same as Alternative C.
Vegetation: Invasive Exotic Plant Species of Concern	Alternative A would have the least potential for increasing invasive plant introduction and distribution.	Alternative B would have the greatest potential to increase invasive plant introduction and distribution. These effects would be moderate. They could be mitigated using invasive plant treatments but the treatments would need to be extensive, would likely require the use of chemical herbicides, and might not always be successful.	Alternative C would have some potential to increase invasive plant introduction and distribution, but the effects would be minor and could be mitigated through mechanical treatments.	Same as Alternative C.
Forest Pests and Pathogens	Alternative A would increase the Forest's resilience to impacts from forest pests and pathogens, and would not increase potential introductions of pests and pathogens.	Alternative B would have the greatest vulnerability to pest and pathogens, and the greatest increase in potential introductions of pests and pathogens. Mitigation measures would likely require extensive use of pesticides, and might not always be successful	Same as Alternative A.	Alternative D would provide the greatest increase in the Forest's resilience to pests and pathogens, and only a minor increased potential for introduction of pest and pathogens. Mitigation measures under this alternative would likely not involve extensive use of pesticides, and would likely be successful.
Natural Disturbances: Fire	Alternative A has the potential to create the greatest vulnerability of the Forest to wildland fires.	Alternative B would have no change on the Forest's vulnerability to wildland fires.	Alternative C would have the potential to increase the Park's vulnerability to wildland fires, but the increases would be minor and could be easily mitigated.	Same as Alternative C.
Natural Disturbances: Weather Events (wind, ice, and snow)	Alternative A would increase the Forest's resilience to impacts from weather events.	Alternative B would have the least degree of overall resilience to, and greatest potential of catastrophic loss from, weather events.	Same as Alternative A.	Alternative D would provide the greatest increase in the Forest's resilience to impacts from natural disturbances.

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Sustainable Management Practices				
Integrated Pest Management: Herbicide Use	Alternative A would likely require minimal herbicide treatments.	Alternative B would require the greatest use of herbicides.	Same as Alternative A.	Alternative D could require limited applications of herbicides in some small-scale areas, but this could likely be avoided by using mechanical treatment instead and in any case would be to a much lesser extent than Alternative B.
Relationship with the Local Forest Economy and Opportunities for Value-Added Products	Alternative A would offer limited opportunities to contribute to value-added product markets and would require minimal involvement of skilled forestry professionals and laborers to implement.	Alternative B would have a greater emphasis on growing softwoods, which would have less opportunity to contribute to local value-added markets, and would require extensive use of forestry work crews.	Alternative C would offer the greatest emphasis on hardwood value-added markets, and would require a diversity of skilled forestry professionals and laborers to implement.	Alternative D would contribute to the greatest diversity of value-added markets than any of the alternatives, and would require a diversity of skilled forestry professionals and laborers to implement.
Financial Sustainability of Forestry Operations	Alternative A would be the least costly to implement	Alternative B would be the most costly of the alternatives to implement and would be unsustainable with the Park's current budgets.	Alternative C would be less costly to implement than Alternative B and would be able to be sustained with the Park's current budgets.	Same as Alternative C.
Effects on Education and Interpretation				
Education and Interpretation Opportunities	Alternative A would provide the fewest opportunities to offer interpretive and education programs related to the Park's mission.	Alternative B would favor interpretation of the history of forest stewardship, but would offer few opportunities to demonstrate contemporary forest practices.	Alternative C would favor the demonstration of contemporary forest practices, but would offer limited opportunities to interpret the history of forest stewardship.	Alternative D would create the greatest diversity of learning opportunities related to the Park's mission.
Effects on Visitor Use and Community Considerations				
Public Access and Recreation	There would be no impacts on recreational uses under Alternative A.	Alternative B would have minor impacts on recreational activities. However, these impacts would be short-term, would only impact small areas in the Park at any one time, and would not restrict the overall use of the Park for any of the permissible recreational activities.	Same as Alternative B.	Same as Alternative B.
Visual Experience	Alternative A would reduce the overall visual diversity of the Forest and would create higher levels of slash throughout the Forest, which could be considered a minor negative visual impact.	Alternative B would maintain the existing visual diversity, but would have major visual impacts when plantations need to be cleared and replanted.	Same as Alternative A.	Alternative D would retain the greatest visual diversity and offer the least visual impacts of the alternatives.

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Soundscapes	Alternative A would have a negligible increase in noise.	Under Alternative B, increase in noise due to forest management activities would be occasional, intermittent, and last for relatively short periods of time. This would result in a minor impact on the soundscapes of the Forest and adjacent areas.	Same as Alternative B.	Same as Alternative B.

5.3 Effects on Integrated Features

As discussed in Section 2.2, there are several key features of the Mount Tom Forest that reflect the influence of both human management and natural processes, and that are integral to both the cultural and ecological integrity of the Park. These features were further described in Sections 4.1 and 4.2. Changes in these "integrated features" could have multiple and diverse effects on other cultural and natural resources at the Park. This section describes how each of the alternatives would influence these integrated features and identifies the specific cultural and natural resources that could be impacted by these changes. The more specific resource impacts are analyzed in Sections 5.4 to 5.8 below.

5.3.1 LANDSCAPE PATCHWORK: COVER TYPES

5.3.1.1 Overview

Cover types describe broad vegetation or land use patterns and include categories such as forest, fields, and open water. The landscape patchwork illustrates the various historical influences that created the Forest, and contributes to the relative abundance and distribution of different animal and plant species.

5.3.1.2 Comparison of Alternatives

Over the long term, all alternatives would maintain the general configuration of forest, agricultural fields, and open water that currently exists. Under Alternative B, there would be some mid-term changes in the patchwork character when plantations are cleared and reestablished. Under Alternatives C and D, a small portion of the Maple Lot bordering the Pogue Stream would be reforested to expand the riparian buffer. The planting would result in a small reduction of the Maple Lot's size at its northern edge over the long term, but would not impact the overall open character of the Lot as experienced from the carriage roads.

5.3.1.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.1 Soils, and 5.5.5 Wildlife: Birds for more in-depth analysis of the various ways changes in cover types would influence related Park resources.

5.3.2 LANDSCAPE PATCHWORK: FOREST STAND TYPES

5.3.2.1 Overview

Forest stand types describe in more specific terms the composition of the forested portions of the landscape patchwork. The forest type is defined by the species composition within the overstory of the forest stands (e.g., northern hardwood forest, Norway spruce plantation, or mixed hardwood and hemlock forest). The Forest is currently composed of seventeen forest types, organized into over fifty different forest stands for management. From a cultural landscape perspective, the diversity and distribution of the forest types are important for illustrating the history of forest management. From an ecological perspective, maintaining the existing forest type in some cases is difficult because of the processes of aging and natural succession. Additionally, management of even-aged, single-species stands is difficult because they are more prone to insects and disease or may offer less desirable habitat for wildlife.

5.3.2.2 Comparison of Alternatives

Under Alternatives A and C, the diversity of stand types would decrease as plantations and early-successional forest stands begin to transition to native forest dominated by later-successional, native hardwood and conifer species. The transition will occur more rapidly under Alternative C because plantation trees and early-successional native species that are considered mature by silvicultural standards would be harvested and management would favor native species. These changes would accelerate the natural processes of forest succession, creating a more ecologically diverse and resilient forest. However, these changes would also diminish the overall historic character that distinguishes Mount Tom as a nationally significant cultural landscape.

Alternative B would retain the most exact representation of the existing stand types. Stands would be harvested and replanted in order to maintain the existing stand types in their current location and to their fullest extent. This would result in short- to mid-term, periodic changes in stand types as cleared plantation areas become reestablished. Over the long term the historic character would be maintained, but the approach would require intensive control of natural regeneration and invasive plants; may leave the Forest more susceptible to insects, diseases, and catastrophic loss; and would reduce the Forest's ecological diversity and wildlife habitat.

Under Alternative D, there would be some change in forest stand types from plantations and early-successional native forest stands to later-successional native hardwoods, but not to the extent of Alternatives A and C. Some plantations or portions of plantations would be maintained as long as possible, encouraged to regenerate with conifer species, or replanted. In a few stands, there would also be some retention of early-successional species, such as in the area surrounding the McKenzie Farmstead where these species illustrate past human habitation (e.g., black locust). Overall, all existing stand types would continue to be represented, but their size and location would change over time. These changes would sustain a rich representation of historic character while enhancing the Forest's ecological diversity and resilience.

5.3.2.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.4 Wildlife: Reptiles and Amphibians, 5.5.5 Wildlife: Birds, 5.5.6 Wildlife: Mammals, 5.5.8 Vegetation: Natural Communities, 5.5.9 Vegetation: Native Plant Species of Special Concern, 5.5.11 Forest Pests and Pathogens, 5.5.13 Natural Disturbances: Weather Events (Wind, Ice, and Snow), and 5.6.1 Integrated Pest Management: Pesticide Use for more in-depth analysis of the various ways changes in forest stand types would influence related Park resources.

5.3.3 FOREST ARCHITECTURE: STAND AGE AND STRUCTURAL DIVERSITY

5.3.3.1 Overview

Forest architecture describes the overall composition and structural characteristics of individual stands. Stand structure includes vertical structure (e.g., even or uneven-aged) and the distribution of size classes (e.g., sapling, pole, sawtimber).

Presently, most of the Park's forest stands are even-aged. Even-aged forest stands tend to have uniform canopy heights and trees of relatively the same age (e.g., date planted in the case of plantations, or date of abandonment for natural stands that have reverted from pasture). Some of the plantations, in particular, are noteworthy for their uniform tree age, size, species composition, and planting pattern, which are an important part of the historic character of the Forest. However, as the plantations and even-aged hardwood stands begin to mature and continue to be harvested, they develop uneven-aged stand characteristics and greater structural diversity. In fact, some of the Park's oldest plantations are beginning to develop late-successional stand characteristics that are notable for their complex vertical structure, including a diversity of tree ages and sizes. As these successional changes occur, the historic integrity of the Forest diminishes, while the ecological benefits increase.

Attempting to maintain even-aged stand structure is highly difficult in light of the natural cycle of tree growth and decline, and the underlying forces of forest growth and change. To maintain this structure requires even-aged management techniques such as overstory removals (i.e., "clear-cutting") that are no longer widely used in the northeastern United States due to a variety of factors including the abundance of natural regeneration, ecological impacts of clear-cutting, and the higher value of hardwood species best grown under uneven-aged conditions.

5.3.3.2 Comparison of Alternatives

With its emphasis on uneven-aged management, Alternative C would result in the greatest and fastest change in overall age classes and structural diversity of the stands. This would occur in both plantations and hardwood and mixed forest stands. Uneven-aged management under Alternative C would increase forest stand resilience to natural disturbances, provide for a continuous yield without heavy removals of the overstory, and allow for timber harvesting in a pattern that is similar to natural disturbance. Alternative A would also result in a more uneven-aged forest composition as trees slowly age, die, and are replaced by younger, more shade-tolerant trees of mostly native species. However, this transition will occur at a much slower rate under Alternative A, which is driven by natural process and not active management as in Alternative C. Under Alternatives A and C, the Forest would develop late-successional forest characteristics and provide greater ecological benefits, but it would lose the representation of single-species, even-aged plantings that were the hallmark of early forestry practices.

Alternative B would attempt to maintain the existing structural conditions of the forest stands as the most exact representation of reforestation techniques and the character of even-aged stands that have naturally regenerated on abandoned agricultural lands. While this would be difficult in light of the ecological forces at work, if it was successful there would be no change in the structural condition of the Forest and it would continue to be composed of primarily even-aged stands with the present distribution of size classes. This Alternative would retain the greatest character of early forestry techniques. However, by limiting the Forest's development, it would also limit the potential to demonstrate the evolution of sustainable forest management or enhance ecological diversity.

Under Alternative D, some areas would be maintained as even-aged plantations, and in other areas even-aged conifer regeneration would be encouraged to grow and provide a new overstory. Therefore, this alternative would have less uneven-aged forest than Alternatives A and C, but more than Alternative B. In this way, representations of the even-aged character that currently exists would still exist in the future, but in different locations and over smaller areas. Uneven-aged stands would cover a greater portion of the landscape, making the Forest more diverse and resilient. Overall, the diversity of stand composition and structure would provide illustrations of historical practices while also demonstrating how

a sustainably managed forest could evolve over centuries of management and enhancing ecological conditions.

5.3.3.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.5 Wildlife: Birds, 5.5.6 Wildlife: Mammals, 5.5.9 Vegetation: Native Plant Species of Special Concern, 5.5.11 Forest Pests and Pathogens, and 5.5.13 Natural Disturbances: Weather Events (Wind, Ice, and Snow) below for more in-depth analysis of the various ways changes in forest stand age and structural diversity would influence related Park resources.

5.3.4 FOREST ARCHITECTURE: DOWNED COARSE WOODY DEBRIS AND SNAGS

5.3.4.1 Overview

Deadwood, which includes downed coarse woody debris and snags (i.e., standing deadwood), are important ecological attributes that provide habitat for a wide range of organisms from bacteria and fungi to cavity-nesting birds and den-dependent mammals (e.g., raccoons, porcupines). Forest assessments indicated that the Forest has a "low" amount of CWD compared to other forests in the region.[2] However, the amount of dead wood in the Forest could impact the cultural landscape character by altering the park-like aesthetic (e.g., views into the forest, well-maintained appearance in the understory).

5.3.4.2 Comparison of Alternatives

Under all of the alternatives the Park would continue to remove snags deemed hazardous to visitor safety in high-use areas, such as the carriage roads. This action represents a continuation of management practices, and therefore would not contribute to changes in the number of snags in the Park relative to current conditions.

However, each Alternative will have different effects on CWD and snags over time. In the long term, Alternative A would generate the greatest amount of CWD and snags because without any active management, large trees would gradually age, decay, and become snags and then eventually CWD. Alternatives C and D would increase CWD levels throughout the Park in the short and long term, because both of these alternatives recognize that retention of deadwood is important to demonstrating best contemporary management practices. Alternative D would limit the type and amount of CWD along some segments of the carriage road corridors in order to maintain a well-kept understory appearance that is important for cultural landscape objectives. However, Alternative D would also create slightly higher numbers of snags in areas where large trees would be retained.

Under Alternative B, CWD and snags would be removed during forest stand treatments and along carriage roads in order to maintain current levels and distribution of deadwood throughout the Park. Therefore, with this alternative there would be no change in CWD or snags over the long term.

5.3.4.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.4 Wildlife: Reptiles and Amphibians, 5.5.5 Wildlife: Birds, 5.5.6 Wildlife: Mammals, and 5.5.12 Natural Disturbance: Fire for more in-depth analysis of the various ways changes in downed coarse woody debris and snags would influence related Park resources.

5.3.5 LEGACY TREES

5.3.5.1 Overview

As discussed in Sections 2.2.3, 4.1.2.3, 4.2.1.10, legacy trees are some of the most identifiable historical features of the landscape, creating an interpretable connection to the past, while also providing valuable habitat to a variety of species and contributing the structural diversity of the Forest. Maintaining existing legacy trees is difficult in light of the natural aging of trees, and cultivating new legacy trees is also challenging because of changes in the landscape (e.g., open areas needed for open-grown growth form are much more limited than 100 years ago).

5.3.5.2 Comparison of Alternatives

Over the long term, Alternative A would create the greatest abundance and distribution of legacy trees with old-growth characteristics because there would not be any active management and most of the stands would begin to develop late-successional forest characteristics. Ecological benefits would increase over time as trees grow, decline, die, and pass through the various stages of decay, each of which supports a diversity of wildlife, insects, fungi, bacteria, and other species. However, certain types of legacy trees associated with the designed characteristics of the Forest, such as sugar maples along the carriage roads, would be lost.

Over the long term, Alternative C would have similar effects as Alternative A but to a lesser extent because active forest management would encourage the removal of mature, well-formed trees. As with Alternative A, under Alternative C certain types of legacy trees related to the designed elements of the landscape would be lost.

Alternative B would maintain legacy trees with both cultural and ecological value. The overall diversity, abundance, and relative distribution of the legacy trees would be comparable to what currently exists.

Alternative D would also maintain legacy trees of both cultural and ecological value, and overall would create the greatest diversity and abundance of legacy trees over the long term. As in Alternative B, legacy trees related to the designed

features of the landscape would be maintained through replanting (e.g., sugar maples along roads), and others would be recruited from within forest stands. Additionally under this alternative, legacy tree recruitment would be used extensively as a tool to retain representative historic trees and their genetic offspring in portions of the plantations that would transition to hardwood and mixed forests.

5.3.5.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.5 Wildlife: Birds, and 5.5.6 Wildlife: Mammals for more in-depth analysis of the various ways changes in legacy trees would influence related Park resources.

5.4 Effects on Cultural Resources

5.4.1 METHODS FOR ASSESSING THE EFFECTS ON CULTURAL RESOURCES

In this section, the impact analyses are intended to comply with the requirements of both NEPA and Section 106 of the National Historic Preservation Act. In accordance with the Advisory Council on Historic Preservation's (ACHP) regulations implementing Section 106 (36 CFR Part 800, Protection of Historic Properties), established criteria were applied to determine potential effects on cultural resources either listed in, or eligible to be listed in, the National Register. The process begins with an identification and evaluation of cultural resources for National Register eligibility, followed by an assessment of effect on those eligible resources, and concluding with a consultation process with the state historic preservation office.

If an action could change the characteristics that qualify the resource for inclusion in the National Register, it is considered to have an effect. As defined by ACHP, *no adverse effect* means there could be an effect, but the effect would not be harmful to those characteristics that qualify the resource for inclusion on the National Register. *Adverse effect* means the effect could diminish the integrity of the characteristics that qualify the resource for the National Register. The intensity definitions presented in Section 5.1 have been modified below to integrate ACHP definitions of no adverse effect and adverse effect, and therefore serve the requirements of both NEPA and NHPA Section 106. These definitions are used for all assessments of potential effects on cultural resources within this section.

- Negligible:
  The impact would be barely perceptible and not measurable, confined to small areas or affecting a single contributing element of a National Register property. Determination of effect for Section 106 would be *no adverse effect*.

- Minor:
  A **minor adverse impact** would alter a single contributing element, pattern, feature or site, but the impact is slight and would not diminish overall integrity. Determination of effect for Section 106 would be *no adverse effect*.
  A **minor beneficial impact** would result in the preservation and maintenance of a feature or historic landscape pattern in accordance with the Secretary of the Interior's Standards. Determination of effect for Section 106 would be *no adverse effect*.

- Moderate:
  A **moderate adverse impact** would be readily apparent; the effect would be harmful to those characteristics that qualify the property for inclusion on the National Register and would diminish the overall integrity of the resource. Determination of effect for Section 106 would be *adverse effect*. A memorandum of agreement with the state historic preservation office to minimize or mitigate adverse impacts would be needed.
  A **moderate beneficial impact** would result in the stabilization or rehabilitation of the cultural resource in accordance with the Secretary of the Interior's Standards. Determination of effect for Section 106 would be *no adverse effect*.

- Major:
  A **major adverse impact** would result in the alteration of a pattern or feature or site disturbance that would diminish the overall integrity of the cultural resource and National Register-listed property. Determination of effect for Section 106 would be *adverse effect*. These adverse impacts would be difficult to mitigate.
  A **major beneficial impact** would result in the restoration and protection of a cultural resource. Determination of effect for Section 106 would be *no adverse effect*.

Several studies were instrumental in identifying and evaluating cultural resources at the Park. These included the Cultural Landscape Report for the Forest, Volume 1 Site History and Volume 2 Existing Conditions and Analysis, and an Archeological Overview and Assessment, among others. These studies were used to assess the potential impacts of the proposed alternatives.

The findings regarding potential effects of the management alternatives for the Mount Tom Forest described in the rest of this section will be shared with the Vermont State Historic Preservation Office (SHPO) in conjunction with the development of a programmatic agreement between the Park and the SHPO for forestry activities and protection of archeological resources once an alternative is selected.

5.4.2 CULTURAL LANDSCAPE CHARACTER: SPATIAL ORGANIZATION, CIRCULATION, AND VEGETATION

5.4.2.1 Overview

In order to continue to maintain the historical significance of the property in the areas of conservation (association with Marsh, Billings, Rockefeller, nineteenth-

century pioneering forestry, and as an example of continuous forest management), landscape architecture, and agriculture, the property must retain its historical character and integrity. As discussed in Section 4.1.1, the character of the Forest is an important component of the property in conveying this significance. Issues of concern for the Forest's historic character include changes in defining landscape characteristics related to spatial organization, circulation system, and vegetation. Potential overarching changes in the Forest's historic character under the different alternatives are described in Sections 5.3.1–5.3.5 above. This section summarizes how those and other changes would affect the Forest's historic character.

5.4.2.2 Effects Common to All Alternatives

Under all of the alternatives, the property will retain the defining landscape characteristics of the historic carriage road and trail circulation system. This historic circulation system is associated with all aspects of the property's historical significance.

5.4.2.3 Comparison of Alternatives

The alternatives differ in the way they would address and maintain defining characteristics of the spatial organization, views from the circulation system, and vegetation associated with the Park's various areas of significance (e.g., association with Marsh, Billings, Rockefeller, nineteenth-century pioneering forestry, continuous forest management, nineteenth-century landscape architecture, and agriculture). Changes in defining landscape characteristics are summarized in Table 6 below.

Table 6
Comparison of Effects on Cultural Landscape Character

	Alternative A **Continue current management**	*Alternative B* **Adopt a "replacement-in-kind" approach to historic preservation**	*Alternative C* **Continue the tradition of applying the best current thinking and practice in forest management**	*Alternative D (NPS-preferred)* **Recognize and work with ecological change in preserving the historic character of the forest**
American Conservationists (National Register Criterion B)				
Marsh (1801–1869)	With a few exceptions, the defining landscape characteristics related to the Marsh period are no longer evident and would not be present in the future. Exceptions include legacy trees that date to the Marsh period, evidence of field boundaries and property markers, and sections of old farm roads. These features would be preserved in all alternatives.			
Billings (1869–1890) and Rockefeller (1954–1997)	Defining landscape characteristics, including the forest plantations and managed character of the hardwood stands, would be lost.	Defining landscape characteristics established by Billings and preserved and expanded by Rockefeller, including the plantations, older hardwood stands, views, and the circulation system would be maintained. However, some characteristics that reflect the continuation of best current thinking and practices in forest management would diminish because management would focus on perpetuating extant features.	Same as Alternative A. However, some views and characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.	Most defining landscape characteristics, including some highly visible plantations, hardwood stands, views, and the circulation system, would be maintained. Although, some plantations would eventually transition to mixed hardwood stands in the long term, and characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.

TABLE 6
COMPARISON OF EFFECTS ON CULTURAL LANDSCAPE CHARACTER

	Alternative A **Continue current management**	*Alternative B* **Adopt a "replacement-in-kind" approach to historic preservation**	*Alternative C* **Continue the tradition of applying the best current thinking and practice in forest management**	*Alternative D (NPS-preferred)* **Recognize and work with ecological change in preserving the historic character of the forest**
American Conservation Movement (National Register Criterion A)				
Pioneering Nineteenth-Century Forestry (1873–1910) and An Example of Continuous Forest Management (1910–1997)	Defining landscape characteristics associated with historic forestry practices would be lost.	Defining landscape characteristics of the plantations and hardwood and mixed forest stands would be maintained. As plantations age and decline, they would be replaced. However, some characteristics that reflect the continuation of best current thinking and practices in forest management would diminish because management would focus on perpetuating extant features.	Same as Alternative A. However, some characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.	Same as Alternative B. Although, some plantations would eventually transition to mixed hardwood stands in the long term, and characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.
Agriculture and Landscape Architecture (National Register Criterion C)				
Model Farm	Defining landscape characteristics associated with the spatial organization and circulation of the model farm would remain evident, including the carriage road system, fields, and The Pogue.	Same as Alternative A. In addition, aspects of early forestry activities associated with a model farm would also be retained.	Same as Alternative A. However, some defining characteristics of the vegetation would be lost and spatial organization would be altered as existing hayfields and pastures would be allowed to convert to shrub-dominated fields.	Same as Alternative B.
Landscape Design During the Country Place Era, (1869–1917)	Defining landscape characteristics of the carriage road system, The Pogue, and overall spatial organization would be retained. However, some views and the designed characteristics associated with the plantations and hardwood and mixed forest stands would be lost.	Defining landscape characteristics of the carriage road system, The Pogue, overall spatial organization, views, and the designed characteristics of the plantations and hardwood and mixed forest stands would be retained.	Same as Alternative A. However, some views and vistas would be retained, although they may not exist in their current location.	Same as Alternative B.

Alternative A would result in the gradual loss of historic landscape character and have the greatest negative impact. Under this alternative, many key historic landscape characteristics related to the property's association with Frederick Billings, Laurance S. Rockefeller, pioneering nineteenth-century forestry, and as examples of continuous forest management would disappear over time. The existing fields would remain open, but the mosaic of distinct plantations would no longer be evident as historic plantations gave way to forest succession. Eventually the plantations and hardwood forest stands would lose the distinctive planting patterns and evidence of forest management, and resemble other second-growth forests in the southern Vermont region. This alternative would retain some landscape characteristics related to the property's significance as a model farm

and as an example of landscape design during the Country Place Era, because road and trail circulation systems and small-scale features would be maintained. However, designed views and the characteristics associated with a managed forest would be lost.

Alternative C would diminish the historic landscape character and result in a negative impact similar to Alternative A. However, since this alternative would continue the practices of contemporary forestry it would retain some defining landscape characteristics associated with the Rockefeller period and the property's significance as an example of a continuously managed forest. This alternative would also maintain some of the views from the carriage roads, and therefore would retain some additional characteristics related to the property's significance as a model farm and example of landscape design during the Country Place Era.

Alternative B would offer the greatest preservation of the Forest's historic character associated with all areas of property's significance. The mosaic and structural character of forest plantations and hardwood and mixed forest stands would be retained through replacement in-kind. All of the existing views would be maintained, and road and trail circulation corridors would include understory and coarse woody debris removal to maintain interior forest views and the existing aesthetic character related to the Rockefeller era. Plant species would include a mix of native and non-native species corresponding to the plants intentionally introduced or regenerated during the historic period. However, under this alternative other defining landscape characteristics associated with the Rockefeller period and continuous forest management would diminish because management would focus on the preservation of existing features, and would no longer continue to apply and demonstrate best contemporary thinking and practices in forest management.

Alternative D offers similar benefits as Alternative B, and would maintain additional landscape characteristics associated with the Rockefellers and continuous forest management. The retention and reestablishment of plantations would occur primarily along the main carriage road corridors and in areas where opportunities exist for encouraging regeneration of plantation species or establishing new small-scale plantings. This would maintain the most defining landscape characteristics of the Forest mosaic (though the exact location and edges would vary over time). While some characteristics may be change over the long term, overall this approach would retain the Forest's historical associations while providing the flexibility to accommodate ecological change. Additionally, by continuing to practice contemporary forest management practices throughout much of the landscape, this alternative would perpetuate additional defining characteristics of the management practices associated with the Rockefeller period and allow the property to evolve as an example of continuous forest management.

5.4.2.4 Section 106 Summary and Conclusions

Overall, Alternative A would have a major adverse effect on the cultural landscape as a result of the loss of the Forest's historic character related to the property's association with Billings, pioneering nineteenth-century forestry, continuous forest management, and landscape design. Under ACHP criteria (36 CFR 800), the Section 106 determination would be an adverse effect. Alternative C also would result in a loss of historic character related to the property's historical significance. However, compared to Alternative A, this alternative would maintain additional defining landscape characteristics of the Forest's association with Laurance S. Rockefeller and continuous forest management. Under this alternative, there would be a moderate adverse impact, and Section 106 determination of adverse effect. Alternatives B and D are consistent with the *Secretary's Standards for the Treatment of Historic Properties*, and would both retain most of the defining landscape characteristics of the Forest related to all areas of property's significance over the long term. Alternative B would retain the most exact representation of historic characteristics through preservation and rehabilitation, and therefore would have a moderate beneficial effect on the cultural landscape resources and a Section 106 determination of no adverse effect. Alternative D would retain representative defining landscape characteristics through preservation and rehabilitation, and would also maintain additional characteristics associated with management under Laurance S. Rockefeller and the property's significance as an example of continuous forest management. This alternative also allows the greatest flexibility to work with the dynamic nature of forest change to ensure the Forest's historic associations are retained over the long term. Therefore, Alternative D would have a minor beneficial effect on cultural landscape resources, and a Section 106 determination of no adverse effect.

5.4.3 ARCHEOLOGICAL RESOURCES

5.4.3.1 Overview

The National Historic Preservation Act requires agencies to take into account the potential effects of their actions on existing or potentially unidentified archeological resources. As discussed in Section 4.1.3, an archeological overview and assessment for the Park is currently underway.

5.4.3.2 Effects Common to All Alternatives

The protection of archeological resources would be the same for all of the alternatives, as described in Section3.3.1. Special considerations for any potential effects to archeological resources will be identified and reviewed in consultation with the Vermont State Historic Preservation Office in conjunction with the development of a programmatic agreement.

5.4.3.3 Section 106 Summary and Conclusions

Under ACHP's criteria (36 CFR 800), actions associated with the implementation of any of the alternatives will be reviewed with the Vermont State Historic Preservation Office and any needed mitigating measures will be applied so that all actions would result in a Section 106 determination of no adverse effect on archeological resources. Therefore, any of the alternatives would have a negligible effect on, and thus will not impair, archeological resources.

5.5 Effects on Natural Resources

5.5.1 SOILS

5.5.1.1 Overview

A summary of soils found in the Park was presented in Section 4.2. All available information on soils was compiled from the NRCS Windsor County Soil Survey and map locations of sensitive soils were compared with locations of proposed forest management treatments. Considerations related to soils included landuse changes on prime agricultural soils, potential erosion or compaction of soils from management activities, and changes in soil nutrients, particularly nutrient exhaustion.

5.5.1.2 Effects Common to All Alternatives

There would be no effects on soils common to all alternatives.

5.5.1.3 Comparison of Alternatives

Prime agricultural soils: The Council on Environmental Quality directs that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) as prime or unique. Prime farmland is defined as soil that particularly produces general crops such as common food, forage, fiber, and oil seed. As discussed in Section 5.3.1 on Cover Types, Alternative D would establish a plantation in a small portion of the Elm Lot. This area is comprised of state-designated prime agricultural soils, and the action would convert a small section of hayfield to a plantation in the long term. There would be no long-term effects on state-designated prime agricultural soils in Alternatives A, B, and C.

Erosion and Loss of Soil: Alternative A would result in the least potential for erosion from forestry activities because active forest management would be minimal, limited to hazardous tree removal along the carriage roads. Alternative C could result in erosion from forestry activities including ground disturbance during harvesting and establishment and use of skid trails. However, if the best management practices outlined in Appendix C are properly implemented, the erosion would be minimal and mitigated on site. Erosion control measures would

be relatively easy to implement and have a high likelihood of being successful. Alternatives B and D have the same potential to contribute to soil erosion from forestry activities as Alternative C. However, Alternative B and, to a considerably lesser extent, Alternative D would have additional impacts because of the process of reestablishing plantations. In order to reestablish plantations under Alternative B, preparation for replanting would include removing all existing trees and slash. This would expose bare soils during the preparation, a condition which will exist until the time the seedlings and a cover crop (e.g., buckwheat or rye) could be established. On-site erosion control measures during this period would be extensive and may not necessarily be successful. Alternative D also calls for the reestablishment of plantations, but only on a small-scale. Since the areas to be replanted are smaller, erosion could likely be mitigated directly on site to prevent loss of soil.

Nutrient Change/Exhaustion: The potential for nutrient change and/or exhaustion is difficult to predict because of the diversity of variables that influence soil chemistry (including larger climatic patterns such as acid deposition). However, the likelihood for changes in soil nutrients is directly linked to drastic changes in vegetation. Management activities that remove large quantities of vegetation over short time-frames, such as the clear-cutting of a stand to reestablish it as a plantation, could result in a rapid release and potential loss of certain nutrients, such as nitrogen.

Over the long term, Alternatives A and C would create the most stable soil nutrient conditions. Some fluctuations of soil nutrients may result as stands age (transitioning from early-successional to mature forests), or immediately after a harvest. However, these changes would be negligible. Alternative B, and to a considerably lesser extent Alternative D, have the potential to create more intensive, long-term alterations to soil nutrients in areas where plantations would be reestablished. However, the overall effect in Alternative D would be minor because the area treated would be small. Under both of these alternatives, nutrient exhaustion could be mitigated by treating the area with nutrient supplements. The treatment for Alternative B would be extensive and have the potential to result in other adverse impacts (e.g., nutrient runoff into waterways.

5.5.1.4 Conclusions

Overall, Alternative B would have the greatest potential for causing moderate adverse effects on soil resources in the long term. These effects could be mitigated with the application of cover crops and the use of best management practices outlined in Appendix C. However, the mitigation measures may need to be extensive and might not be successful. Alternatives C and D have the potential for causing minor adverse effects, which could be easily mitigated if the best management practices outlined in Appendix C are successfully implemented. Alternative A would have negligible effects on soil resources. None of the

alternatives would have major adverse impacts on soil resources and, therefore, would not impair this resource.

5.5.2 WATER RESOURCES AND WETLANDS

5.5.2.1 Overview

Management of Park wetlands are subject to and guided by the Clean Water Act, Executive Order 11990 Protection of Wetlands, and Natural Resource Management Manuel, #77-1 Wetland Protection. These laws and policies direct the NPS to protect and enhance the natural and beneficial values of wetlands, and to avoid or minimize potential impacts to wetlands. Additionally, NPS Management Policies direct the Park to minimize impacts to watershed processes (e.g., runoff, erosion, vegetation, and soil disturbance) and stream processes that create habitat features (e.g., riparian systems, woody debris accumulations, gravel bars, riffles, and pools).[3]

As discussed in Section 4.2.3, there are no National Wetland Inventory (NWI) classified wetlands in the Park. However, more detailed inventories of wetlands, springs, seeps, streams, and vernal pools were mapped and assessed as part of several Park resource studies. Impacts to water quality and quantity are related to management practices near and adjacent to these resources, and/or cumulatively throughout the watershed. The potential effects of each alternative on water resources and wetlands were evaluated by assessing the proximity of proposed management activities to these resources, and the potential cumulative effects of collective actions within the watershed. Considerations related to water resources and wetlands included sediment loading, pollution, nutrient change, alteration of baseflow volumes, and thermal changes.

5.5.2.2 Effects Common to All Alternatives

There would be no effects on water resources and wetlands common to all alternatives.

5.5.2.3 Comparison of Alternatives

Sediment Loading: Sediment loading describes the amount of soil particulates entering a waterbody. Sediment is one of the main pollutants that affect freshwater bodies in the Northeast. Sedimentation of streams and ponds can cause adverse effects by changing patterns in water flow, filling macroinvertebrate and fish habitats, covering breeding areas and eggs, and altering the availability or abundance of light reaching aquatic vegetation. Forest management activities can contribute to sediment loading through ground disturbances and loss of vegetative cover resulting in soil erosion. Potential impacts on soil erosion were analyzed in Section 5.5.1 above. In general, Alternative B has the potential to cause the greatest sediment loading in Park streams, seeps, and wetlands; and Alternative A has the least potential for impact. Under all of the alternatives, best

management practices discussed in Appendix C would be applied to mitigate some of these impacts. However, mitigation measures for Alternative B would be extensive and might not be successful.

Nutrient Changes: Nutrients, such as nitrogen and phosphorus, are important to the health of the Park's streams and The Pogue. However, in excess they can become a pollutant, adversely affecting these waterbodies. Alterations in vegetation within a watershed can directly affect nutrient levels in surface water. Changes in nutrients were discussed under soil nutrient change/exhaustion above (Section 5.5.1). Overall, Alternative B has the greatest potential to alter soil and water nutrient balances during plantation removal and reestablishment. If soil enhancements are used to mitigate soil exhaustion, this could potentially increase the amount of nitrogen, phosphorus, and other nutrients entering surface waters. Alternative D has the potential for the same type of negative effects, however any that did occur would likely be minor. Alternatives A and C would create negligible impacts on water nutrient changes.

Thermal Changes: Another important function of vegetation is to shade surface water. Streams, seeps, and wetlands without vegetative cover experience greater fluctuations in temperatures that negatively affect aquatic life. Under all of the alternatives, best management practices described in Appendix C would be followed, which includes maintaining vegetative buffers along streams, seeps, wetlands, and open water. These measures should be adequate to mitigate potential negative impacts from forest management activities under Alternatives A, C, and D. However, even with proper implementation of best management practices, Alternative B would result in minor short-term increases in water temperatures when plantations are cleared and reestablished because the runoff from of these sites would be exposed to greater sunlight and warmer soils.

Water Quantity and Distribution: In addition to alterations in water quality, changes in vegetation can directly alter water quantity, particularly baseflow of streams, seeps, wetlands, and streams. Baseflow is precipitation (e.g., rain, snowmelt) that percolates through the soil and into the groundwater before being slowly released into surface waters. Alteration in baseflow may result when there are changes in the amount of vegetation in an area and stormwater can directly enter streams, seeps, etc. This direct runoff can overwhelm the system, creating greater stream channel erosion, spikes in pollutants and nutrient levels, and diminish the amount of water entering ground reserves. Vegetation assists in regulating baseflow by intercepting runoff, allowing it time to percolate into the soil and groundwater or absorbing it directly through their roots. Alternative B would create the greatest fluctuations in baseflow during the removal and reestablishment of plantations. These changes would be moderate and short-term, persisting until the area is revegetated. The forest management activities proposed in Alternatives C and D would not likely result in significant changes in baseflow

over the long term. Likewise, the changes in vegetation composition under Alternative A would not likely result in significant changes in baseflow.

5.5.2.4 Conclusions

Overall, Alternative B would have the greatest potential for causing moderate adverse effects on water resources. Some of these effects could be mitigated with the use of best management practices outlined in Appendix C. However, the mitigation measures may need to be extensive and might not necessarily be successful. Alternatives C and D also have the potential for causing adverse effects, but these effects would be minor and could be easily mitigated if the best management practices outlined in Appendix C are properly implemented. Alternative A would have negligible effects on water resources. None of the alternatives would have major adverse impacts on water resources and wetlands and, therefore, would not impair these resources.

5.5.3 WILDLIFE: SPECIES OF CONCERN

5.5.3.1 Overview

Federal agencies are required by the Endangered Species Act of 1973 to consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that their actions do not jeopardize the continued existence or critical habitat of any species listed as endangered or threatened. There are no federally listed threatened or endangered species known to occur within the Park. There are also no state-listed threatened or endangered species known to occur. There is, however, one species, the Jefferson salamander, on the Vermont list of Species of Special Concern. The potential impact to this species is analyzed in Section 5.5.4 below on reptile and amphibian populations. Additionally, several bird species that have been confirmed to breed in the Park are listed as a "special concern" by the Vermont Agency of Natural Resources, on the Vermont list of rare and uncommon birds, or on the Partners in Flight priority list for the northern New England region. The potential impact of the alternatives on these species is discussed in Section 5.5.5 below on bird populations.

5.5.3.2 Conclusions

None of the alternatives would have major adverse effects on, and thus will not impair, wildlife species of concern. As required by the Endangered Species Act, the Endangered Species Coordinator with the U.S. Fish & Wildlife Service was consulted, and concurred with these findings.[4]

5.5.4 WILDLIFE: REPTILES AND AMPHIBIANS

5.5.4.1 Overview

As discussed in Section 4.2.4.1, an assessment of the abundance and distribution of reptile and amphibian populations and vernal pools in the Park was conducted.

More specific information about the habitat use and migratory patterns of the Jefferson salamander, a state-listed species of concern, was developed as part of a second, more in-depth study. Considerations related to reptiles and amphibians included changes in vegetation in and adjacent to wetlands and vernal pools; retention of coarse woody debris (CWD) for habitat cover and feeding areas; soil compaction and ground disturbance from forestry activities; and habitat linkages that provide potential connections between populations in vernal pools in and adjacent to the Park.

5.5.4.2 Effects Common to all Alternatives

There would be no effects on reptile and amphibian populations common to all alternatives.

5.5.4.3 Comparison of Alternatives

Type of Forest Cover in "Life Zones": The type of forest within life zone areas (i.e., a 200-meter radius extending from the breeding pools) can influence the viability of amphibian populations. Native hardwood and mixed conifer stands provide better habitat for amphibian populations than single-species conifer plantations or open fields. Conversion of plantations and fields to native tree cover in life zone areas would enhance habitat conditions for amphibians. Changes in forest stand types were discussed in Section 5.3.2 above. Overall, in the long term, Alternatives A, C, and D would result in the eventual conversion of conifer plantations in life zone areas into native hardwood forests and therefore would enhance amphibian habitat. The intentional transition of plantations to natural communities through forest management would occur more quickly under Alternative C, creating major beneficial short-term to mid-term benefits for reptile and amphibian populations. Conversion of plantations in Alternatives A and D would occur more slowly as plantations age and hardwoods become established and mature. Under Alternative B, conifer plantations would remain within the amphibian life zones, limiting the suitability of the habitat for most reptiles and amphibians in both the short and long term.

Coarse-Woody Debris for Habitat Cover and Feeding Areas: CWD is considered important for many species of amphibians and reptiles, particularly in amphibian life zone areas. Changes in Park-wide CWD levels were analyzed in Section 5.3.4 above. Overall, Alternatives A, C, and D would increase downed CWD, with Alternative A yielding slightly higher volumes of CWD in the long term. Under Alternative B, there would be no change in CWD levels in either the short or long term.

Habitat Linkages: Open fields and single-species conifer plantations with limited understory vegetation located between breeding areas can create barriers to reptile and amphibian migration and negatively impact meta-population dynamics (i.e., limit genetic diversity). The conversion of these areas into native hardwood

or mixed forest stands would enhance opportunities for reptile and amphibian habitat connections. The eventual conversion of plantations to native hardwood and mixed forest stands in Alternatives A and C would provide the greatest opportunities for habitat connections. Alternative D would offer some increased opportunities for habitat connections, but under this alternative some plantations would be retained in areas between existing breeding vernal pool habitat. Under Alternatives C and D, a small strip of the hayfield in the north end of the Maple Lot adjacent to the Pogue Stream would be reforested to provide riparian habitat, which could be important to many species of amphibians. Alternative B would not provide any change in habitat connectivity.

Soil Compaction: Ground-disturbing activities from forestry activities could negatively impact reptile and amphibian habitat, such as soil compaction from the use of heavy equipment within life zone areas. Alternative A would have the least potential for ground disturbance and compaction of soils because no significant timber harvesting would occur. Under Alternatives B, C, and D, soil compaction and ground disturbance from forestry activities could potentially impact amphibian populations. Opportunities to minimize compaction and ground disturbance through winter logging may be restricted by ski trail easements and the desire to scarify the soil to encourage certain types of regeneration (e.g., white pine).

Water Resources and Wetland Habitat: Changes in water resources and wetlands, which were analyzed in Section 5.5.2 above, would have the potential to impact amphibian habitat. Overall, Alternative B would have the greatest potential for causing moderate adverse effects on water resources and wetlands, and thus amphibian populations, which may not be able to be mitigated successfully. Alternatives C and D could cause minor negative impacts to water resources and wetlands, but these impacts could be mitigated if best management practices in Appendix C are property implemented. Alternative A would negligibly impact water resources and wetlands.

5.5.4.4 Conclusions

Overall, Alternative A would have moderate beneficial impacts to reptile and amphibian habitat and populations in the short and long-term. Alternative C would provide beneficial impacts comparable to Alternative A; however, some soil compaction from forestry operations would occur under this alternative. Alternative D would provide less habitat enhancement compared to Alternatives A and C, but would still provide beneficial impacts to reptile and amphibian habitat. Alternative B would not enhance reptile and amphibian habitats or populations, and could have minor negative impacts to amphibian populations because of its potential effects on water quality and wetlands. None of the alternatives would have major adverse impacts on the existing reptile and amphibian populations and, therefore, would not impair these populations.

5.5.5 WILDLIFE: BIRDS

5.5.5.1 Overview

A summary of bird species found in the Park was presented in Section 4.2.4.2. More than ninety species have been identified, several of which are considered priority species by various agencies and organizations. Because species diversity is linked to habitat diversity, any changes to vegetation structure and diversity, edge habitat, hayfield management, and abundance of snags may affect bird populations.

5.5.5.2 Effects Common to All Alternatives

The timing of field mowing relative to bird life cycles is important to minimize direct impacts to grassland nesting species. As discussed in Section 3.3.2, under all alternatives grassland birds will be given adequate time to fledge their first brood before field mowing commences.

5.5.5.3 Comparison of Alternatives

Forest Type, Structure, and Diversity: Vegetation structure and species diversity are important for food and nesting habitat for birds. Changes in stand structure and species diversity were analyzed in Sections 5.3.2 and 5.3.3 above. Overall, Alternatives A and C offer the greatest amount of native hardwood and mixed forest habitat and more diverse understory conditions, which are preferred by many bird species. These conditions would develop much more quickly in Alternative C than in Alternative A because of active forest management. Alternative D would also create an increase in native hardwood and mixed forest habitat, and greater understory diversity. However, this would be to a lesser extent than in Alternatives A and C because some of the plantations will be retained and replaced, and some areas along the main carriage road corridor will be thinned or cleared to maintain views into the forest.

Additionally, as plantations age, they provide valuable habitat for diverse bird populations. Some of the older plantations have started to develop a more diverse understory and have the greatest diversity of bird species in the Park.[5] Alternatives A and C would allow existing plantations to continue to evolve, and would retain and enhance this habitat type for birds. Alternative D would also allow some plantations to develop these characteristics, but not to the same extent as Alternatives A and C.

Alternative B would provide the least favorable conditions for bird habitat because single-species, even-aged plantations would be retained and reestablished to the greatest degree and understory vegetation would be continue to be suppressed in the plantations and other portions of the Forest.

Snags and Cavity Trees: Snags and live trees with deadwood and cavities are important to many cavity-nesting bird species. Snags near the edge of fields are preferred by some species, such as American kestrels. Changes in the density of snags and legacy trees (which have the potential to become valuable cavity trees) were analyzed above in Sections 5.3.4 and 5.3.5, respectively. Overall, Alternatives A, C, and D would increase snags in the long term, but Alternative A would provide more snags in the long term as none of these trees would be culled to favor healthier trees. Alternatives C and D would also retain some large-diameter trees as legacy trees, which will eventually become cavity trees and snags as they age and die. Under Alternative B, legacy trees would be retained, but other snags would continue to be removed from areas throughout the Park; therefore there would be no significant change in snag numbers in either the short or long term.

Interior and Edge Habitat: The amount of edge habitat considered desirable varies depending on the bird species; some prefer edge and others prefer interior forest habitats. Due to the high number of forest interior species that are also considered conservation priorities in the region, forest interior may be the most important habitat to consider for the benefit of bird populations. Alternatives A and C would maximize forest interior habitat in the long term. Alternative D also would increase interior habitat, but to a lesser extent than Alternatives A and C because some plantations would be retained. Alternative B would retain existing levels of forest interior habitat; this would be the least of the four alternatives.

Alternative B would maximize the amount of edge habitat in the Park because all plantations would be retained. Alternative D would retain some of the plantations, making it the second most favorable alternative for edge habitat. Alternative C would increase edge habitat in the short and mid-term due to active forest management. Alternative A would minimize edge habitat over the long term as plantations convert to mixed hardwood forests without active forest management.

Field Management: The field management approach under Alternative C would provide the greatest benefits to bird populations that favor or require early-successional habitat. The fields would be maintained as rich herbaceous, early-succession woody vegetation by mowing every second or third year, enhancing their value as ecologically diverse communities not represented elsewhere in the Park. Field management under Alternatives A, B, and D would involve annual mowing. This would retain the habitat for grassland nesting birds. However, the fields would be maintained in their current species mix of agricultural grasses. This would provide some benefit to a few grassland bird species, but not to the same extent as the native early-successional grasses and shrubs in Alternative C would provide to other species.

5.5.5.4 Conclusions

Overall, Alternative A would provide moderate beneficial impacts to the greatest number of bird species as habitats mature. It would have the most positive impact

on cavity nesting and forest interior bird populations, no change to grassland birds, and the least amount of forest edge in the long-term. Alternatives C and D would provide minor benefits to bird species that require cavities for nesting, forest interior, and edge habitats. Alternative C would also provide some early-successional habitat that is absent from the other alternatives. Alternative B is unlikely to have any noticeable impact on bird populations over the long term because there would be the least divergence from current habitat conditions. None of the alternatives would have major adverse impacts to the existing bird populations and, therefore, would not impair these populations.

5.5.6 WILDLIFE: MAMMALS

5.5.6.1 Overview

Information on mammals known to inhabit the Park is summarized in Section 4.2.4. Considerations in analyzing the potential effects of the alternatives on mammals include levels of coarse woody debris and snags, carriage roads as bat travel corridors, vegetation cover type and structure, and mast trees.

5.5.6.2 Effects Common to All Alternatives

Carriage roads are important bat corridors, and will be managed the same under all alternatives. The primary feeding area for bats is The Pogue, which will also be managed the same under all alternatives.

5.5.6.3 Comparison of Alternatives

Coarse woody debris and snags: Dead wood provides valuable habitat to a diversity of mammal species. Cavities provide important bat nurseries and denning habitat for numerous other species (e.g., porcupine, squirrels). Large-diameter CWD on the forest floor is important for small and medium-sized mammals, providing cover, denning, and foraging areas. Levels of CWD and snags were analyzed in Section 5.3.4 above. Overall, Alternatives A, C, and D would increase the amount of deadwood in both the short term and long term. Alternative A would provide slightly more deadwood in the long term; and Alternative C has the greatest potential to increase CWD in the short term because of active forest management. Alternative B would provide the fewest snags and least amount of CWD of any of the alternatives.

Forest Type, Structure, and Diversity: Vegetation type, structure, and species diversity are important attributes of mammal habitat. While certain changes in vegetation can favor one species over another, in general a greater diversity of mammal species can be expected if there is greater structural and species diversity within a stand. Changes in forest type, stand structure, and species diversity were analyzed in Sections 5.3.2 and 5.3.3 above. Overall, Alternatives A and C offer the greatest amount of native hardwood and mixed forest habitat, more diverse understory conditions, and late-successional forest characteristics, which are

preferred by many small and medium-sized forest mammals. These conditions would develop more quickly in Alternative C because of the active forest management. Alternative D would also result in an increase of native hardwood and mixed forest habitat, greater understory diversity, and late-successional stand characteristics in some plantation and hardwood stands. However, this would be to a lesser extent than in Alternatives A and C because under Alternative D some portions of the plantations would be retained and replaced as even-aged, single-species stands.

Alternative B would maintain the existing forest cover and structural diversity, which includes large areas of single-species even-aged conifer plantations and which would provide the least overall beneficial habitat to mammal species. However, the reestablishment of even-aged stands which would provide some characteristics of early-successional habitat in the mid-term, which is preferred by some mammal species.

Mast Trees: Mast trees are trees that produce food for a variety of wildlife, especially mammals. Alternative C would retain the greatest number of mast trees intentionally through forest management. Alternatives A and D would result in an increase in mast trees, but not to the extent of C. Under Alternative B, there would be no change in the availability of mast-producing trees, as hardwood /conifer proportions would be kept largely the same as the current distribution across the landscape.

5.5.6.4 Conclusions

Alternative C would have the greatest beneficial effect on mammal populations in the short and mid-term because it would create the most diverse forest structure and plantations would be converted to natural communities. Alternative A also would provide moderate beneficial impacts to mammal populations over the long term as trees mature and die and plantations transition to natural communities. Alternative D would have similar beneficial impacts as Alternative C over time, but to a lesser extent because some portions of plantations would be retained. Alternative B would not enhance mammal habitat. None of the proposed alternatives would have major adverse impacts on existing mammal populations and, therefore, would not impair these populations.

5.5.7 WILDLIFE: FISH

5.5.7.1 Overview

As described in Section 4.2.4.6, the only fish populations in the Park are species that were introduced in The Pogue. In accordance with the deed restrictions associated with the property, recreational fishing will not be allowed under any of the alternatives. Issues considered important when examining potential impacts to fish populations included changes in water quality and habitat along the edge of The Pogue.

5.5.7.2 Effects Common to All Alternatives

There is unlikely to be a significant impact to fish populations under any of the alternatives as The Pogue's water quality will continue to be protected under all scenarios. The band of trees around The Pogue will be minimally treated as necessary for aesthetics and safety reasons. Under Alternatives A, C, and D, no forestry activities are anticipated for the steep slopes to the west of The Pogue, and most other slopes adjacent to The Pogue have moderate slopes and would remain in continuous forest cover, limiting the possibility of siltation or increased water temperature due to loss of canopy. Under Alternative B, plantations on the slopes north of The Pogue would be removed and replaced. During plantation reestablishment, erosion control measures would be applied. They would likely be extensive and, if successful, there would be negligible impacts to fish populations.

5.5.7.3 Conclusions

As long as the best management practices outlined in Section 3.3.2 and Appendix C are properly applied to protect the water quality of The Pogue, none of the alternatives would negatively impact, or impair, fish populations at the Park.

5.5.8 VEGETATION: NATURAL COMMUNITIES

5.5.8.1 Overview

As stated in Section 4.2.1.2, natural communities are interacting assemblages of species and their environment (e.g., soils, slope, aspect, and climate). The Park currently includes sixteen different natural community types. Natural community analysis provides a baseline to describe the effects of the alternatives on the development of the Forest's potential natural communities. There are also existing natural communities that have been identified in the Park as unique or ecologically sensitive (see Section 4.2.1.3). Assessing the changes to existing natural communities of special concern is also valuable in comparing the overall impacts of the alternatives on the Park's ecological resources.

5.5.8.2 Effects Common to All Alternatives

Differences in field management between alternatives would not influence natural community development in those areas as there would be no conversion to natural communities under any of the alternatives, save for a small strip adjacent to the Pogue Stream, which would be converted under Alternatives C and D.

In addition, there would be no forest management activity in the rich northern hardwood forest to the west of The Pogue under any of the alternatives due to its steep slopes and proximity to The Pogue.

5.5.8.3 Comparison of Alternative Impacts

Changes in forest stand types were described in Section 5.3.2 above. In general, Alternatives A, C, and D would enhance the extent and species composition of

potential natural communities at the Park. This change would happen to the greatest extent in Alternative A because there would be no active management influencing forest species composition. The forest stands would eventually evolve into the most complete representation of their potential natural communities under this alternative.

A significant transition to native plant communities would also occur in Alternative C, but at an accelerated rate. Management would encourage native species in plantation areas because this is in keeping with current thinking for best management of northeastern hardwood forests. There would be a gradual change from existing stand types to potential natural communities as native species regenerate, take hold in the understory, and eventually become dominant as existing mature trees and competing non-native trees are removed. This process would occur over the mid- to long term, as best management practices would still favor the retention of non-native species through their maturity into merchantable timber. This Alternative may not allow the natural communities to reach their full potential species composition and character as in Alternative A, because forest management may favor a greater retention of certain species because of their silvicultural value.

Alternative D would create a more gradual change in the Park's natural communities than in Alternative C, but the transition would be more rapid than under Alternative A. There would also be less area involved in the conversion of plantations to potential natural communities than in Alternatives A or C because some portions of the plantations would be retained. Additionally, the McKenzie site and orchard would be managed to retain some species associated with the homestead (e.g., black locust and apple trees).

Under Alternative B, there would be no changes to the existing natural communities, and no increased benefits to natural communities throughout the Park. Stands would be managed to retain their current species mix and even-aged character, and would not revert to their potential natural community.

5.5.8.4 Conclusions

Overall, Alternative A would have the greatest beneficial impacts on the development of natural communities at the Park. Alternative C would also expand the representation of natural communities throughout the Park, but may not allow them to develop to their full potential. Alternative D would provide the same beneficial changes as C, but to a somewhat lesser extent. Alternative B would not change the existing natural community composition, and therefore would not provide any beneficial impacts to natural community development. None of the alternatives would have major adverse impacts on existing natural communities and, therefore, would not impair these resources.

5.5.9 VEGETATION: NATIVE PLANT SPECIES OF SPECIAL CONCERN

5.5.9.1 Overview

Native plant species of special concern found at the Park are described in Section 4.2.1.4. These species could benefit or be adversely affected by changes in forest type, diversity, and structure (which were discussed in Sections 5.3.2 and 5.3.3 above), and impacts from forestry activities (e.g., ground disturbances).

5.5.9.2 Effects Common to All Alternatives

Under all of the alternatives, forest management activities would be excluded from areas with identified native plant species of special concern (see Section 3.3.2). Therefore, forest management activities (e.g., ground disturbance, changes in canopy closure) would not adversely impact identified plant species of concern.

5.5.9.3 Comparison of Alternatives

The alternatives would differ in their effect on habitat associated with native plant species of special concern. Alternative A would have the greatest beneficial impact on native species of special concern because plantations would eventually be replaced by natural communities. Alternative C also would have potential beneficial impacts to plant species of concern because the amount of habitat that would be suitable for these species would be increased by actively transitioning plantations to native hardwood and mixed forest stands. Alternative D also would have the potential for increasing suitable habitat to species of concern, but not to the same extent as Alternative C. Alternative B would have the fewest changes in habitat, and populations of plant species of special concern would remain largely unchanged.

5.5.9.4 Conclusions

Overall, Alternative A would have a moderate beneficial impacts on habitat associated with native plants of special concern. Alternatives C and D would have minor beneficial impacts to native plant species of concern, but to a lesser extent than Alternative A. There would be no direct impacts to or changes in habitat for plant species of concern under Alternative B. None of the proposed alternatives would have major adverse impacts to the existing plant species of concern and, therefore, would not impair these resources.

5.5.10 VEGETATION: INVASIVE EXOTIC PLANT SPECIES OF CONCERN

5.5.10.1 Overview

Executive Order #13112 on invasive species requires federal agencies to prevent new invasive introductions; detect, monitor, and rapidly respond to/control current infestations in a cost-effective and environmentally sound manner; and educate the public about invasive impacts and control methods. This executive order also prohibits federal agencies from authorizing, funding, or carrying out

actions that they believe are likely to cause or promote the introduction or spread of invasive species.

Non-native invasive plants have the potential to disrupt ecological systems and change the character of the forest composition. Once established in an area, non-native invasive plants can out-compete native shrubs and trees, alter the availability and type of cover and food for wildlife, and influence the historic character of a stand by changing the overall species composition and structure. As discussed in Section 4.2.1.5, non-native plants have been identified in the Park. Forest management activities proposed in this Plan can influence the potential introduction and distribution of invasive plants throughout the Park. Important considerations that influence the potential introduction, distribution, and intensity of treatment for invasive plants include ground disturbances and canopy openings created during forest treatments (i.e., thinning, harvesting, timber stand improvement).

5.5.10.2 Effects Common to All Alternatives

Under all alternatives, the potential introductions of invasive exotic plants could pose an adverse effect on Park resources and would be treated to manage or eradicate the threat. Such actions could include the use of herbicides and mechanical treatments (e.g., using hand-tools for weed removal).

5.5.10.3 Comparison of Alternatives

Alternative A proposes the least amount of forest management activities, and therefore offers the least potential opportunity for increased introduction and distribution of invasive plants.

Alternative B proposes the greatest intensity of forest treatments that would result in ground disturbances and large openings in the forest canopy, particularly as plantations are cleared and reestablished. Therefore, this alternative would create the greatest potential introduction and distribution of invasive plants. However, this alternative also recommends that the current species composition would be retained, thus encouraging the removal of any new introductions of non-native invasive plants that would result from these treatments. While there would be no net change in non-native invasive plant distribution, the treatment approach would require intensive mechanical or chemical control of invasive plants in those areas over the short and mid-term.

Alternatives C and D also would involve forest treatments that create ground disturbances and some canopy openings, but not to the extent of Alternative B. Alternative D also proposes small-scale establishment of plantations, and therefore would have some potential for the introduction of non-native invasive plants as would be the case under Alternative B. However, compared to Alternative B, these areas would be relatively small and invasive plant control could be accomplished primarily through mechanical control measures.

5.5.10.4 Conclusions

Overall, Alternative B would have the potential to create the greatest threat of invasive plant introduction and distribution. These effects would be moderate. They could be mitigated using invasive plant treatments; but the treatments would need to be extensive, would likely require the use of chemical herbicides, and might not always be successful. Alternatives C and D also would have the potential to increase invasive plant introduction and distribution, but the effects would likely be minor and could be mitigated primarily through mechanical treatments. The treatments would be less extensive than in Alternative B, and would have a greater likelihood of being successful. Alternative A would have the least potential for increasing invasive plant introduction and distribution.

5.5.11 FOREST PESTS AND PATHOGENS

5.5.11.1 Overview

Pests and pathogens are an important factor to consider in forest management because they affect the health of trees and hence the productivity and appearance of the Forest. As described in Section 4.2.6.1, assessments of forest pest and pathogens at the Park were conducted as part of a long-term forest dynamic monitoring program and site observations by professional foresters. Additionally, a risk analysis of the potential likelihood and impact of hemlock woolly adelgid was conducted in 2005.[6] Important considerations that influence the likelihood of pest and pathogen challenges include the diversity of species and age classes of forest stands (resilience) and risk of introduction of non-native invasive pests or pathogens (i.e., hemlock woolly adelgid, emerald ash borer, Asian longhorn beetle, etc.).

5.5.11.2 Effects Common to All Alternatives

Under all of the alternatives, there would continue to be a risk of introduction of non-native invasive pests and pathogens from forest management activities (i.e., hazardous tree treatments), maintenance of fields, and visitor use activities (i.e., hiking, horseback riding). As described in Section 3.3.2, the Park would treat populations of pests and pathogens that pose a risk to the Forest. Such treatments could include the use of pesticides and mechanical treatments (e.g., removal of infected trees). The Park will also implement measures to monitor and mitigate the effects of forest pests and pathogens under any of the alternatives. Additionally, a nursery will be established to cultivate replacement trees and shrubs for Park needs, which would decrease the potential of unintentional introduction of non-native invasive pests and pathogens from Park planting activities.

5.5.11.3 Comparison of Alternatives

Forest Stand Type, Diversity, and Structure: Forest stand diversity is an important consideration when assessing potential impacts of pests and pathogens because diversity reduces the portion of the forest that can be affected by any

one type of pest (for example, a forest that is completely hemlock is far more vulnerable to hemlock woolly adelgid than a mixed forest). This diversity also helps the forest as a whole respond to loss of trees or entire species groups from pests or pathogens (e.g., resilience). Analysis of changes in forest stand types and diversity was discussed in Sections 5.3.2 and 5.3.3 above. Overall, Alternative D would create the most resilient forest because it offers the greatest diversity in stand types and some increased diversity of stand age classes. Alternatives A and C would have slightly less overall resilience compared to Alternative D because there would be less diversity in forest stand types across the Park. However, these alternatives would also increase species and age-class diversity within the stands and thereby enhance the Forest's resilience. Alternative B would also offer a diversity of stand types throughout the Park, but many of these stands would be monoculture plantations which have the greatest degree of vulnerability to pests and pathogens. An introduction of a pest or pathogen that affects species in these stands would require extensive pesticide treatments in order to maintain the plantation.

Additionally, under Alternative B the reestablishment of conifer plantations in an even-aged manner (overstory removal or "clear-cutting" and planting seedlings) would also make them more susceptible to both native and non-native insects and diseases which prefer open sunlight (e.g., white pine weevil and white pine blister rust), increasing the likelihood that pesticides would be needed in order to grow healthy trees of desirable form. Under Alternative D, the approach to regenerating conifers in the understory would reduce the likelihood of weevil and blister rust damage and the corresponding potential need for chemical treatment. Additionally, under this alternative the plantations established in open areas would be small and any pest or pathogen outbreak would likely be easy to mitigate.

Risk of Pest and Pathogen Introduction: Under Alternative B, the amount of trees needed to reestablish plantations and maintain the existing composition of hardwood stands would exceed the capacity of the planned on-site nursery. Therefore, there would be a higher risk of pest and pathogen introduction from bought nursery stock purchased from off-site nurseries. Alternative D also proposes reestablishment of some plantation areas. However, the areas would be smaller and therefore sufficient numbers of seedlings could potentially be provided by the proposed nursery. No direct planting is planned in either Alternative A or C; therefore these alternatives would not pose any additional risk of pest and pathogen introduction from nursery stock.

5.5.11.4 Conclusions

Alternative B offers the least resilience and greatest risk of pest and pathogen introduction and therefore would create the greatest risk of negative effects due to pest and pathogens. Mitigation measures under this alternative would likely

require extensive use of pesticides, and might not always be successful. Alternative D would provide the greatest degree of diversity and only a minor increased potential for introduction of pest and pathogens. Mitigation measures under this alternative would likely not involve extensive use of pesticides, and would likely be successful. Alternatives A and C offer less overall stand type diversity throughout the Park but greater diversity within stands, and would not increase potential introductions of pests and pathogens.

5.5.12 NATURAL DISTURBANCE: FIRE

5.5.12.1 Overview

Wildland fires are an important consideration in forest management plans, particularly as changes in recreational use and logging activity could result in an increased potential for people or equipment to start fires.

5.5.12.2 Impacts Common to All Alternatives

As stated in Section 3.3.2, in order to protect the Park's cultural resources and reduce the potential for damage to adjacent property, the Park will take action to suppress all wildland fires within the Park's boundaries, regardless of their origin.

Fine fuels are considered to be the carrier of fire. Most of the Park's forest has a continuous cover of ground fuels in the form of leaf litter, organic materials and woody debris. Regardless of changes in cover type, these fine fuels would remain throughout the Forest.

5.5.12.3 Comparison of Alternatives

Heavier coarse woody debris (e.g., downed fuels) and standing deadwood (e.g., snags) determine the intensity of fire. The alternatives would differ in terms of the Forest's overall vulnerability to and potential magnitude of wildland fires because of different amounts of this type of ground fuels that would be created under each of the alternatives. Changes in levels of CWD and snags were analyzed in Section 5.3.4 above. Overall, Alternatives A, C, and D would increase both CWD and snags in both the short and long term. Alternative A would provide substantially more CWD and snags in the long term, and therefore create the highest risk of a more widespread, intense fire. Alternative B would provide the fewest number of snags and least amount of CWD of any of the alternatives, therefore the Forest's vulnerability to wildfire would likely be slightly less under this alternative.

5.5.12.4 Conclusions

Overall, the likelihood of significant wildland fire is small under any of the alternatives because of the suppression steps the Park will take regardless of which alternative is selected. However, Alternative A has the potential to create the greatest vulnerability of the Park's forest to wildland fires, which could have major adverse effects on Park resources. Alternatives C and D have the potential

to increase the Park's vulnerability to wildland fires, but the increases would be minor and could be mitigated by keeping fuels away from structures, carriage roads, and the Park boundary. Alternative B would have no change on the Park's vulnerability to wildland fires.

5.5.13 NATURAL DISTURBANCES: WEATHER EVENTS (WIND, ICE, AND SNOW)

5.5.13.1 Overview

The risk of impacts from damaging weather events is important to consider in forest management because weather events are a common type of disturbance that could impact cultural resources and ecological systems. The risk of impacts from weather events varies depending on the approach to forest management used and conditions of forest stands. Potential impacts from weather events were based on the overall resilience of the Forest as defined by forest stand diversity. In general, the more overall diversity there is in the Forest, the greater the likelihood that the system can respond to and recover from extreme weather events.

5.5.13.2 Effects Common to All Alternatives

There would be no effects common to all alternatives related to the Forest's vulnerability to damaging weather events.

5.5.13.3 Comparison of Alternatives

Analysis of changes in forest stand types and diversity was discussed in Sections 5.3.2 and 5.3.3 above. Alternative D offers the greatest diversity in stand types and some increased diversity of stand age classes. Alternatives A and C would have slightly less overall resilience compared to Alternative D because there would be less diversity in forest stand types across the Park. However, these alternatives would also increase species and age-class diversity within the stands and thereby enhance the Forest's resilience. Alternative B would also offer a diversity of stand types throughout the Park, but many of these stands would be even-age, monoculture plantations which have the least degree of overall resilience to extreme weather events.

5.5.13.4 Cumulative Effects and Conclusions

Alternative D offers the greatest opportunities for the Forest to resist and respond to changes from natural disturbances. Alternatives A and C would have slightly less overall resilience compared to Alternative D. Alternative B would have the least degree of overall resilience to, and greatest potential of catastrophic loss from, natural disturbances.

5.6 SUSTAINABLE MANAGEMENT PRACTICES

5.6.1 INTEGRATED PEST MANAGEMENT: HERBICIDE USE

5.6.1.1 Overview

As stated in Section 4.3.2, the Park practices an Integrated Pest Management approach to address unacceptable levels of pests. In an IPM approach, chemical and biological controls are only used when other available options are either not acceptable or not feasible. Sections 5.5.10 and 5.5.11 above discussed the degree to which pesticide use would be required under each of the alternatives to address populations of invasive exotic plants and forest pests and pathogens. In addition to treating invasive exotic plants and forest pest and pathogens, pesticides might also be used to manage native vegetation to create the desired forest composition and character. The alternatives would differ in the degree to which chemical control measures would be necessary to achieve the desired forest character.

5.6.1.2 Effects Common to All Alternatives

There would be no effects common to all alternatives.

5.6.1.3 Comparison of Alternatives

Under Alternative B, a concerted effort would be made to maintain the existing forest stands in their current species composition and character, including even-aged monoculture conifer plantations and early-successional forest. However, as discussed in Sections 2.3 and 5.3.2, these forested areas are naturally changing to include a greater component of native late-successional species. In order to control native regeneration and allow conifer seedlings to become reestablished, herbicide use and/or mechanical treatment (e.g., hand lopping) would be necessary. Given the large size of some of the areas that would require treatment (plantation sizes range up to 22 acres), use of substantial amounts of herbicides would be likely. Additionally, herbicide treatment might also be required to maintain current species composition in the naturally regenerated stands.

Alternative D also proposes to manage some conifer stands to perpetuate a dominant conifer composition or, in a few cases, establish new small-scale plantations. However, under this alternative a strategy of encouraging existing conifer regeneration would be pursued, and mechanical treatment (e.g., hand lopping) would be a feasible option for managing the competing hardwoods because of the small areas being considered for initiating new plantations.

Under Alternatives A and C, there would be greater flexibility to allow the species composition of the Forest to change in response to native plant regeneration. Except for treating non-native invasive populations of plants, insects, and disease, as discussed under Sections 5.5.10 and 5.5.11, these alternatives would not require herbicide use.

5.6.1.4 Conclusions

In general, Alternative B may require intensive use of herbicides in order to suppress native species regeneration to achieve the desired forest character, which would negatively impact Park IPM strategies for reducing pesticide use. Alternative D could require limited applications of chemical treatments in some small-scale areas, but this could likely be avoided by using mechanical treatments. In any case, herbicide use under Alternative D would be to a much lesser extent than Alternative B. Alternatives A and C would likely require the least intensive chemical treatment to achieve the desired forest character.

5.6.2 RELATIONSHIPS WITH THE LOCAL FOREST ECONOMY AND OPPORTUNITIES FOR VALUE-ADDED FOREST PRODUCTS

5.6.2.1 Overview

As discussed in Section 4.2, the role of the productive forest in the local economy was an important factor driving Billings to begin his reforestation efforts on Mount Tom. The Forest has continued to contribute to the local economy since that time, and the Park's forest management will sustain that relationship (see Section 3.3.3). In assessing the effects of the alternatives on this topic, important considerations include the relative amounts of wood products harvested from forestry operations that could contribute to value-added markets, and the relative amounts of labor by forestry professionals that would be needed to accomplish the forest management program envisioned for each of the alternatives.

5.6.2.2 Effects Common to All Alternatives

There would be no effects common to all alternatives.

5.6.2.3 Comparison of Alternatives

Value-Added Products: The alternatives will differ in terms of the amount of wood they could contribute to local value-added markets. Alternative A would offer the least opportunity for contributing value-added products to local markets because of the limited timber harvesting that would occur under this alternative. Over the long term, Alternative C would favor growing late-successional native hardwood species, which are most suited for local value-added markets. Alternative D would have the potential to contribute the greatest diversity of wood products for value-added markets. Like Alternative C, it would offer a greater production of hardwoods and could also provide unique large-dimensional wood to specialty markets (e.g., large timbers for repairing historic bridges) because some portions of the conifer plantation would be maintained and the trees would be allowed to grow to large-diameter sizes. Alternative B would have a greater emphasis on growing softwoods, which would have less opportunity to contribute to local value-added markets.

Professional Forestry Services: Under all alternatives, local forestry professionals would be involved to some degree; however, the extent of their involvement

and range of skills required would differ between Alternatives. Alternative A would require the least involvement of local forestry professionals because active forest management would be limited. Alternatives B, C, and D would all require a diversity of skilled professionals and laborers to implement the forestry work proposed under each alternative. Alternative B would require the highest amount of labor in order to maintain plantations and the species composition of hardwood and mixed forest stands, remove competing hardwood regeneration, and control invasive plants.

5.6.2.4 Conclusions

Alternatives B, C, and D all offer potential benefits to the local forest products economy. Alternative C would offer the greatest overall opportunity to provide hardwood products to value-added markets, and would require a diversity of skilled forestry professionals and laborers to implement. Alternative B would have a greater emphasis on non-value-added softwood markets and would require extensive labor investment from local forestry professionals. Alternative D would contribute to the greatest diversity of value-added markets of any of the alternatives, and require a diversity of skilled forestry professionals and laborers to implement. Alternative A would offer limited opportunities to contribute to value-added product markets, and minimal involvement of skilled forestry professionals and laborers to implement.

5.6.3 FINANCIAL SUSTAINABILITY OF FORESTRY OPERATIONS

5.6.3.1 Overview

The Marsh-Billings-Rockefeller Fund of the Woodstock Foundation was created by Mary and Laurance S. Rockefeller, and is dedicated to preservation and conservation work, including forestry, in the Park. It is anticipated that revenue generated from forest management activities will be returned to the endowment to support the ongoing forestry work.

As discussed in Section 5.6.2 above, the alternatives would differ in the amount of labor needed to implement them successfully. The associated costs of labor, as well as supplies (e.g., herbicides), are important considerations for assessing the overall financial sustainability of the forestry operations of each of the alternatives.

5.6.3.2 Effects Common to All Alternatives

There would be no effects common to all alternatives for this topic.

5.6.3.3 Comparison of Alternatives

Alternative A proposes a forest management program that would be the least costly to implement. Expenses would be limited to hazardous tree management and occasional responses to forest damage from weather events or pests. Alternative B proposes a forestry program that would be the most costly to implement. Under Alternative B, the effort to retain, reestablish, and maintain

the plantations would require intensive mechanical and/or chemical intervention with corresponding costs in supplies, labor, harvesting equipment, and personnel. Forest management costs under Alternatives C and D would be substantially less than Alternative B because these alternatives would work with the natural processes of stand development and therefore would not be dependent on, or have associated cost related to, extensive chemical or mechanical intervention. Alternative D would have some additional costs associated with the reestablishment of small-scale plantations, but these would be substantially less than Alternative B.

5.6.3.4 Conclusions

Overall, Alternative B would be the most costly of the alternatives to implement and would be unsustainable under the Park's current budgets. Alternatives C and D would be significantly less costly to implement than Alternative B; and Alternative A would have minimal implementation costs. The forest management programs under Alternatives A, C, and D could all be sustained with the Park's current budgets.

5.7 Effects on Education and Interpretation

5.7.1 EDUCATION AND INTERPRETATION OPPORTUNITIES

5.7.1.1 Overview

As described in Section 4.4, the Park seeks to strengthen the human commitment to stewardship by engaging in educational initiatives and resource management activities that tell the evolving story of conservation; demonstrate sustainable forest management; and encourage reflection, dialogue, and lifelong learning. The type of forest management activities proposed under each of the alternatives would have the potential to influence the range of educational and interpretive opportunities that could be conducted at the Park. In particular, the degree to which contemporary forest stewardship would be practiced under the different alternatives would impact the Park's overall ability to demonstrate sustainable forest management and to invite the public to participate in hands-on learning opportunities that encourage exploration and discussion of contemporary stewardship. Likewise, the degree to which examples of early forest management practices would be retained by the different alternatives would influence the Park's ability to interpret the evolving story of conservation.

5.7.1.2 Effects Common to All Alternatives

As stated in Section 3.3.4, under all of the alternatives the Park will continue to offer a diversity of programs for teachers, students, professionals, landowners, and the general public on topics of conservation and stewardship.

5.7.1.3 Comparison of Alternatives

Alternative A would provide the fewest opportunities to demonstrate sustainable forest management, provide hands-on learning activities that explore contemporary stewardship practices, or demonstrate the evolving nature of forest conservation. This alternative would provide opportunities for exploring the processes of natural forest evolution, although this is not a primary focus of the Park's interpretive mission.

Alternative B would also provide limited opportunities to demonstrate sustainable forest management or provide hands-on learning activities that explore contemporary stewardship practices. However, this alternative would offer the greatest opportunities for visitors to experience examples of reforestation and forest management techniques that were prevalent from the late nineteenth-century to the end of the twentieth century.

Alternative C would offer a greater diversity of opportunities to demonstrate sustainable forest management and provide hands-on learning opportunities about contemporary stewardship practices. However, as with Alternative A, over the long term there would be fewer opportunities to demonstrate and interpret examples of early reforestation and forest management practices that illustrate the evolution of forest conservation.

Alternative D would offer the greatest range of interpretive and educational opportunities. Representative plantations would be maintained or created to illustrate the evolution of forest management practices. Elsewhere, best current thinking and practices in forest management would be applied to create demonstrations and opportunities for the public to learn about contemporary sustainable forest management practices.

5.7.1.4 Conclusions

Overall, Alternative D would create the greatest diversity of learning opportunities related to the Park's mission. Alternative B would favor interpretation of the history of forest stewardship from Billings' initial plantations to the end of the Rockefeller period, and offer few opportunities to demonstrate contemporary forest practices. Alternative C would favor the demonstration of contemporary forest practices, and offer limited opportunities to interpret the history of forest stewardship. Alternative A would offer the fewest opportunities to offer interpretive and education programs related to the Park's mission.

5.8 Effects on Visitor Use and Community Considerations

5.8.1 PUBLIC ACCESS AND RECREATION

5.8.1.1 Overview

As discussed in Section 4.5, recreation has always been an important part of the Park's history. The Park's 20 miles of carriage roads and trails provide extensive opportunities for hiking, snowshoeing, cross-country skiing, horseback riding, and orienteering. Forest management activities proposed in the alternatives could impact opportunities for, and quality of, recreational activities in the Park. In particular, access to certain areas of the Park could be limited during forest management activities because of concerns for visitor safety and some recreational uses may conflict with forestry activities (e.g., maintaining groomed trails for skiing while conducting winter harvesting).

5.8.1.2 Effects Common to All Alternatives

As discussed in Section 3.3.5, under all alternatives the current permissible recreational activities will continue. The carriage roads and trails will be maintained at their current extent and level of care, and potentially hazardous trees will be managed along these corridors. Some former skid trails may be revegetated in the long-term, but this would minimally alter the road and trail network or existing recreational uses. Additionally, as outlined in the conditions of the property's deed and easement held by the Woodstock Resort Corporation, any winter forest management activities would be conducted in a manner that would not impact the Woodstock Resort Corporation's operation and maintenance of the cross-country ski trail system. Also, the Park will establish a notification system to inform visitors about any active forestry operations, temporarily closed areas, and recommended alternative areas in the Park for recreational activities.

5.8.1.3 Comparison of Alternatives

Alternative A would entail limited forestry activities, and therefore would have minimal impact on recreational uses. Alternatives B, C, and D have the potential to impact recreational use in small areas of the Park on a short-term basis when forestry activities are in progress. It is anticipated that most forest treatment activities would require between one to thirty working days to complete. Operating equipment and felling activities could pose hazards to visitors or conflicts with some recreational uses (e.g., startle horses, create noise impacts during hiking experiences). However, the notification system described above should eliminate potential hazards and minimize conflicts.

5.8.1.4 Conclusions

There would be no impacts on recreational uses under Alternative A. In Alternatives B, C, and D, forest management activities would have minor impacts

on recreational activities. However, these impacts would be short-term, would only impact small areas in the Park at any one time, and would not restrict the overall use of the Park for any of the permissible recreational activities.

5.8.2 VISUAL EXPERIENCE

5.8.2.1 Overview

As described in Section 4.6.3, the Park is a unique visual resource for the Woodstock area. Additionally, as discussed in Section 4.1.2, the diversity of visual qualities of forest stands, fields, and open water is one of the Forest's most striking historic characteristics and a source of visitor enjoyment. The forestry activities proposed in the alternatives would alter the forest composition in the long term. Additionally, during and immediately following forestry activities, the visual qualities of forest stands could potentially be altered by increased amounts of slash (e.g., coarse woody debris) and ground disturbance. Forest treatments also could enhance the visual quality of the Forest in the short and long term (e.g., maintaining vistas, thinning understory vegetation to create views into the forest, etc.).

5.8.2.2 Effects Common to All Alternatives

There would be no effects common to all alternatives for this topic.

5.8.2.3 Comparison of Alternatives

Alternative A would have the greatest effect on the existing visual resources in the Park. Under this alternative, as the forest matures there would be increased crowding, limited views into the forest, and a change in the Park's overall forest composition to predominantly native hardwoods in both the short and long term. This would limit the diversity of views and scenic experience from the carriage roads and trails, and diminish the characteristics that distinguish the Park from surrounding forests when viewed from different locations in Woodstock. Additionally, with the limited amount of forestry activity, over the long term there would be substantial quantities of coarse woody debris in the Forest.

Alternative C would have similar impacts on visual resources as Alternative A in terms of changes in forest composition. Under this alternative, vistas along the carriage road to adjacent lands would be maintained, but the practice of thinning and removing the understory to create views into the forest along the carriage road would not be continued.

Alternative B would most closely replicate the visual qualities of the Forest that exist today over the long term. It would maintain the current composition and character of forest stands, internal and external views, and would remove slash from forest management activities to maintain the existing aesthetic appearance along the carriage roads and trails. However, this alternative also recommends

replacement of plantations as they age and decline. The process of replacing plantations would require removal of trees over large areas (in some cases, more than 20 acres). The clear-cutting and soil disturbance created during these treatments would extensively alter the visual experience of the Park and views of the Park from Woodstock. These visual impacts would persist until the replanted trees become established (i.e., approximately twenty-five to fifty years after they are planted).

Alternative D would retain the diversity of the existing visual qualities along the primary carriage road corridors. Elsewhere, plantations would transition to native hardwood and mixed forest stands, offering less visual contrast with the surrounding hardwood forest. However, these stands would be managed to retain remnant plantation trees and legacy trees over the long term, thus creating a forest with a strong sense of history and overall diversity. The approach may diminish some of the characteristics that distinguish the Park from the surrounding landscapes. However, key views of the Park from Woodstock (e.g., from along the eastern part of Route 12, and from Route 4 looking up to the larch and spruce plantations) would retain their unique character. Under this alternative, vistas along the carriage roads to the surrounding landscape and selective views from the carriage roads into the Forest would be maintained. Slash from forestry activities would be minimized along the primary carriage road corridors, but not removed from elsewhere in the Forest. The reestablishment of plantations under this alternative would not be extensive and would not require large-scale clearing as in Alternative B; therefore, the visual qualities of the Forest would not be extensively impacted.

5.8.2.4 Conclusions

Overall, Alternative D would retain the greatest visual diversity and offer the fewest visual impacts of the alternatives. Alternative B would maintain the existing visual diversity, but would have major negative visual impacts when plantations are cleared and replanted. Alternatives A and C would reduce the overall visual diversity of the Forest and would result in higher levels of slash throughout the Forest, which could be considered a negative visual impact.

5.8.3 SOUNDSCAPES

5.8.3.1 Overview

Director's Order #47 requires the NPS to protect, maintain, or restore natural soundscape resources in a condition unimpaired by inappropriate or excessive noise sources, to the fullest extent practicable. Although ambient noise levels have not been measured in the Forest, the existing soundscape can be inferred based on noise levels typically associated with similar land uses (e.g., associated with residential, agriculture, and natural areas). For the land uses in and around the Park, noise levels of 60 to 75 dB are generally considered normal and acceptable.[7]

Impacts from noise production are generally assessed with respect to changes in noise levels experienced at sensitive receptors (e.g., adjacent residents, schools, churches, and areas with threatened and endangered wildlife). Changes in sound levels in the Park, particularly extensive increases in the time and intensity of sound from forestry equipment, could adversely affect visitor experiences, nearby residences, and the use of the area by wildlife.

5.8.3.2 Effects Common to All Alternatives

There would be no effects related to soundscapes that would be the same under all alternatives.

5.8.3.3 Comparison of Alternatives

Under Alternative A, there would be limited use of chainsaws and other forestry equipment for hazardous tree management, mowing fields, and repairing roads.

Alternatives B, C, and D would have the same sources of noise as Alternative A, but the amount of noise from forestry equipment (e.g., chainsaws, tractors, forwarders, skidders, and logging trucks) would increase relative to current conditions. Forest management activities would occur occasionally throughout the year under all three of these alternatives. It is estimated that forestry equipment and vehicles would operate for no more than eight hours per day and most treatment activities would last between one to thirty days. Sound levels from forestry equipment would range from 60 decibels to 103 decibels; the noise would not be continuous.[8]

There are several nearby residences that border the Park. The majority of those closest to the Park are on the southeastern border near the Mansion Grounds and within the village of Woodstock. This area of the Park also has sensitive wetland habitat, and would not likely receive any extensive forest management treatments under any of the alternatives. In most instances, forestry activities would be removed both in distance and in topography from nearby residences, and the noise levels would be reduced by the terrain, foliage, or other site variables.

In addition to these potential effects on adjacent residents, visitors and wildlife also could be disturbed during forestry operations. Visitors would be informed of where forestry activities were occurring and could select alternative routes to avoid noise disturbances during the short times that forestry work is underway. Since this disturbance would be only occasional and short-term, any displaced wildlife would likely move back into suitable habitat in the same general area after treatments.

5.8.3.4 Conclusions

Under all of the alternatives, forestry operations would contribute to an increase in noise. Under Alternative A, the increase would be negligible. Under Alternatives

B, C, and D, the increase in noise would be occasional, intermittent, and last for relatively short periods of time. This would result in a minor impact on the soundscapes of the Forest and adjacent areas, but would not impair soundscape resources of the Park.

5.9 Other Topics Considered, But Dismissed from Further Analysis

NEPA emphasizes the importance of adjusting the scope of each environmental assessment (EA) to the particulars of the project and its setting, and focusing on the specific potential impacts of that project. There is no need to assess potential impacts on resources that are either not present or would not be affected by the alternatives in any measureable way. For this EA, topics that were identified as not requiring detailed analysis included geological resources, floodplains, air quality, Indian Trust resources, ethnographic resources, and environmental justice in minority and low-income populations. Each is discussed briefly below.

5.9.1 GEOLOGICAL RESOURCES

The Park's geological resources were assessed by consulting existing state-wide surficial and sub-surface geological maps (see Section 4.2.2). Locations of rock outcrops that were historically altered as part of the road-building activities were recorded and mapped in the Cultural Landscape Report for the Forest. Activities in this Plan primarily address vegetation management and preservation of existing features related to the carriage roads, including rock outcrops. It is not anticipated that activities proposed by any of the alternatives would affect geological resources. Therefore, this topic was dismissed from further analysis.

5.9.2 FLOODPLAINS

Executive Order 11988 requires federal agencies to examine potential risks and impacts of management activities on floodplains. The project area is not within a 100- or 500-year floodplain.[9] Therefore, this topic was dismissed from further analysis.

5.9.3 AIR QUALITY

The 1963 Clean Air Act, as amended (CAA) (42 USC 7401 et seq.), provides for the protection of air quality–related values (including visibility, plants, animals, soils, water quality, cultural and historic objects, and visitor health) on federal lands from adverse air pollution impacts. Under all of the alternatives, the Park will work with the NPS Northeast Temperate Inventory and Monitoring Program and other agencies to assess changes in air quality and its related effects on Park resources. (See Section 3.3.6 for further discussion.)

The Clean Air Act and the NPS 2001 Management Policies also recognize the need to analyze impacts to air quality during park planning. Section 118 of the CAA requires the Park to meet all federal, state, and local air pollution standards. Section 176(c) of the CAA requires all federal activities and projects to conform to state air quality implementation plans to attain and maintain National Ambient Air Quality Standards. The Park is located in a mandatory Class II clean air area.[10] Under the CCA, maximum allowable increases of sulfur dioxide, particulate matter, and nitrogen oxide beyond baseline concentrations established for Class II areas cannot be exceeded. Under any of the alternatives, emissions from forestry activities (e.g., from the operations of forestry equipment) would be short-term, localized, and would have a negligible effect on regional or local pollutant levels. Therefore, this topic was dismissed from further analysis.

5.9.4 INDIAN TRUST RESOURCES

Secretarial Order 3175 requires that any anticipated impacts to Indian Trust resources from a proposed project or action by U.S. Department of Interior agencies be explicitly addressed in environmental documents. The Federal Indian Trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. There are no Indian Trust resources in the Park. The lands comprising the Park are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indians. Therefore, Indian Trust Resources was dismissed from further analysis.

5.9.5 ETHNOGRAPHIC RESOURCES

As described in Section 4.1.4, an ethnographic resource is any "site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it." The relationship between the Mount Tom Forest and the local community has been an important part of the property's history. As outlined in the General Management Plan and established in the deed that conveyed the property to the NPS, some long-standing uses of the property by local residents (e.g., hunting, fishing, camping, campfires, motor vehicles, mountain biking, and swimming) are prohibited. These restrictions will be adhered to under any of the alternatives. Views to and of the Park from Woodstock village and other surrounding locations are also part of the local community's connection with the property. Potential effects of the alternatives on visual resources were analyzed in Section 5.8.2 above. Aside from those considerations, there would be no effect on ethnographic resources under any of the alternatives. Therefore ethnographic resources were dismissed from further analysis.

5.9.6 ENVIRONMENTAL JUSTICE IN MINORITY AND LOW-INCOME POPULATIONS

Executive Order 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects on minority and low-income populations. None of the alternatives would have health or environmental effects on minorities or low-income populations or communities. Therefore, this topic was dismissed from further analysis.

5.10 Cumulative Effects

The term "cumulative effects" is a NEPA term that relates to overall effects on the environment that could result from a potential federal action when added to the effects of other past, present, and reasonably foreseeable future actions regardless of who may initiate such action or where they may occur. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.[11]

In the context of this Plan, the consideration of actions that could contribute to cumulative effects on the resources of the Forest can be reasonably divided into two primary geographic contexts: on-site actions (i.e., within the Park and Forest itself) and broader actions (i.e., regional and global actions and trends that may be beyond the control of the Park).

With respect to the effects of on-site actions, prior actions within the Forest from Frederick Billings' time through the Rockefellers' tenure are directly responsible for creating the diversity of significant resources for which the Park was established. Since the Park's establishment, NPS management actions in the Forest have been limited and conservative because of the recognized need for a thoughtfully developed plan that would identify an overall management direction and specific guidelines and actions that would protect and enhance the Park's significant values. Future on-site actions will be consistent with this Plan and any subsequent revisions or amendments, which will ensure that the cumulative effect of on-site actions will not impair Park resources.

There are many broader actions and external changes that may affect the Forest, but that cannot be fully assessed when comparing the different alternatives. For example, these broader changes could include changes in atmospheric deposition and climate, alternations in adjacent land use, or new introductions of invasive exotic plants, pests, or pathogens. The complexity and magnitude of these changes are difficult to predict, assess, and control. However, the Park recognizes that the long-term viability of the Forest and its significant resources could be influenced by changes in external conditions. To address these unknowns, the Park is committed to an adaptive management approach that will include an ongoing

program to monitor these trends and adjustments to management activities in response to external change (see Sections 3.3.6 and 4.7).

5.11 Impairment

Impairment is an impact so severe that, in the professional judgment of a responsible NPS manager, it would harm the integrity of Park resources or values and violate the 1916 NPS Organic Act.[12] Based on the analysis of impacts presented in Sections 5.4 to 5.10 above, Alternatives B and D would not impair any Park resources. However, Alternatives A and C would diminish the Forest's historic character related to the property's association with Frederick Billings, pioneering nineteenth-century forestry, continuous forest management, and landscape design. These changes would result in a major or moderate adverse impact on cultural landscape resources. Under the provisions of the National Historic Preservation Act and associated regulations, the impacts of these alternatives on the integrity of the cultural landscape would be considered adverse effects, and therefore could be considered an impairment of cultural landscape resources.

5.12 Environmentally-Preferred Alternative

In accordance with the National Environmental Policy Act and agency policies, the National Park Service is required to identify the "environmentally preferred alternative(s)" for any of its proposed projects. In essence, the environmentally preferred alternative would be the one(s) that "causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources."[13]

More specifically, the environmentally preferred alternative is determined by applying criteria established in the National Environmental Policy Act and promulgated by the Council on Environmental Quality (CEQ). The CEQ directs that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. This includes alternatives that:

1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

2) Ensure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;

3) Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;

4) Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;

5) Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and

6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

Of the four alternatives presented in this Plan, Alternative D is the environmentally preferred alternative because it addresses these NEPA goals most completely. It would provide the greatest simultaneous retention of the Forest's historic landscape character and enhancement of the Park's ecological values, educational opportunities, and sustainable operations.

Over the long term, Alternative A would create a greater degree of ecological diversity, but it would have major adverse effects on some of the Park's historic cultural landscape resources. Alternative C would have moderate adverse effects on some cultural landscape resources, although it would maintain the traditions of sustainable forest management and foster greater ecological diversity. Alternative B would preserve the Park's historic characteristics to the greatest degree, but in so doing would have numerous adverse effects on natural resources, aesthetics, and sustainable operations.

5.13 NPS-Preferred Alternative

Alternative D is the NPS-preferred alternative because it offers a strategy for holding on to many of the historic characteristics of the Forest by maintaining broad landscape patterns and representative features, while also recognizing the challenges of ecological change in managing a dynamic cultural landscape. Alternative A takes no long-term proactive steps to address this fundamental challenge. Alternative C defines the "essential character," rather narrowly by focusing only on continuing the tradition of applying the best current thinking and practices in forest management, and thus failing to preserve some of the historic landscape features that illustrate the unique legacy of forest management that gives the Forest its national significance and enduring sense of history. Applying Alternative B to re-create the historic softwood plantations would be in direct conflict with the ecological conditions faced today. To attempt to turn back the clock on forest growth and change under this alternative would require intensive clear-cutting and removal of competing regeneration, either through labor-intensive manual treatments or herbicide applications. This would be inconsistent with the conservation mission of the National Park Service and outside the norms of contemporary ecosystem and sustainable forest management, and would undermine the financial sustainability of the Park's operating budgets.

By emphasizing the integration of natural and cultural values, Alternative D reflects a promising direction in conservation philosophy and practice. Alternative D combines an historic preservation perspective that incorporates the role and influence of natural succession and ecological processes, and a natural resource conservation perspective that is informed and shaped by a sense of history and stewardship.

Endnotes to Part 5

[1] NPS 2001.
[2] Keeton 2005.
[3] NPS 2001.
[4] VanOttigen July 10, 2005.
[5] Keeton 2005.
[6] Machin et al. 2005.
[7] HUD 1991.
[8] Measurements of noise generation during forest management activities at the Park are not available. Data are from the Occupational Safety and Health Administration (OSHA) and Louisiana Forest Products Development Center, Louisiana State University Agricultural Center (2003). Measurements for forestry equipment are based on average readings taken 10 feet from equipment operating at full throttle.
[9] ESRI/FEMA 2002.
[10] NPS 1999.
[11] CEQ NEPA Regulations, 40 C.F.R Part 1508.7
[12] NPS 2001.
[13] NPS 2001.